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EPA Superfund
Record of Decision:

CALHOUN PARK AREA
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CHARLESTON, SC
09/30/1998

EPA 541-R98-104
<IMG SRC 981040>

ENFORCEMENT
RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

CALHOUN PARK SUPERFUND SITE
CHARLESTON, CHARLESTON COUNTY
SOUTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Calhoun Park Area Superfund Site
Charleston, Charleston County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Calhoun Park Area Superfund Site (the Site) in Charleston, South Carolina, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C º 9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300 et seq. This decision is based on the administrative record for this Site. The State of South Carolina, acting as a support agency, concurs with the selected remedy.

ASSESSMENT OF THE SITE

Existing soil and groundwater contamination at this Site, consists mainly of BTEX and PAHs, is attributable to the previous manufactured gas plant operations. Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to human health.

DESCRIPTION OF THE SELECTED REMEDY

This remedial action addresses NAPLs source areas, shallow groundwater contamination, and contaminated soil as the principal threat at this Site. Sediment and surface water contamination, in addition to intermediate groundwater contamination will be addressed in a separate ROD.

The major components of the selected remedy include:

- Excavation and transportation of contaminated soils to a permitted landfill followed by the backfilling of the excavated areas with clean fill;

- Source removal of NAPLs from both the shallow and intermediate aquifer;

- Treatment of groundwater plume through a combination of recovery wells/filtration system and phytoremediation;

- Additional sampling of surface water and sediment, following mitigation of coal tar discharge into Cooper River, to fully delineate extent of contamination and potential threat to aquatic and terrestrial life.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. The groundwater portion of, the remedy was based on EPA's expectation that the remediation of groundwater to MCLs will be challenging given the presence of NAPLs at this Site. Therefore a phased approach has been selected consisting of removal or treatment of NAPL to the maximum extent practicable, followed by containment of potentially non-restorable source areas, and restoration of aqueous contaminant plumes.

This selected remedy will result in contaminated groundwater remaining on-Site above health-based levels until remedy implementation is complete. Therefore, five (5) year reviews will be conducted after initiation of remedial action to insure that the remedy continues to provide adequate protection of human health and the environment.
<IMG SRC 98104A>

FIGURES

TABLES

APPENDIX

1.0 SITE NAME, LOCATION, AND DESCRIPTION

The Calhoun Park Area Superfund site (hereinafter referred to as "the site") is located in Charleston, South Carolina. The general location of the site is depicted in Figure 1-1. The site consists of an electrical substation and an abandoned city park as well as portions of the Ansonborough Homes housing project, Ludens Marine, and the National Park Service property.

The site under investigation initially consisted of an 18 acre area comprising an electrical substation, an abandon city park, and the Ansonborough Homes housing project. Based on initial sampling data the investigation was later expanded to include Ludens Marine, the National Park Service property, the George E. Campsen property Dockside Condominiums, and the Deyton property. Presently these properties consists of a mixture of industrial, commercial and residential land usage. A detailed figure of these properties is illustrated in Figure 1-1.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Previous Site Operations

Historically the various properties which comprise the site have been used for several purposes including a manufactured gas plant (MGP), a steam generating plant, a sawmill, a rosin wood treating operation (Fernoline Chemical), and a shipyard. The MGP operated on the location of the present electrical substation. The Ludens marine property originally housed a steam plant supporting the MGP operations. This same building was later converted to a ship repair/marine retail store known as Ludens Marine. Both the sawmill and the rosin wood treating company operated at the present location of the abandon city ballpark. The rosin wood treating operations also utilized portions of the Ansonborough Homes property. Shipyard operations were previously performed at the present location of the NPS property, Dockside condominiums, and the Deyton property.

While many of these past operations may have contributed to the environmental impact upon this area, the MGP was the major contributor for contamination at this site. This is evidenced from both the composition of waste present and the distribution of this waste relative to the former MGP location. For these reasons the following historical information focuses on the MGP operations.

Manufactured Gas Plant operations began at the site in the 1850's with the construction of a Manufactured Gas Plant (MGP) located on the property presently occupied by the electrical substation. Manufactured gas, also referred to as town gas, was produced at the site under two basic processes known as coal carbonization and carbureted water gas. The MGP was originally constructed in 1855 as a coal gasification plant and operated in this manner until 1910 at which time operations were converted to a carbureted water plant which continued to produce gas until the plant closed in 1957 **1**.

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The coal carbonization process consisted of three steps where coal was first heated to generate a gas. The gas was then collected and cooled using both a condenser and scrubber. The gas was then purified by passing the gas through a filter material and finally sent to a gas holder tank for storage. The carbureted gas operations consisted of passing steam over a bed of hot coal which generated a product called "blue gas". To enrich the heat value of blue gas, it was next passed through a carburetor unit. In this unit oil was sprayed over hot bricks in the presence of blue gas. This process in turn produced an oil-enriched blue gas. The oil-enriched gas was passed through a super-heater where the oil vapors were "cracked" to simpler gasses. Finally the gas was then sent through the condenser/scrubber/purifier process and sent to the gas holder tank for storage.

Waste areas typically associated with MGPs include the general area surrounding the gas holder tanks. Here waste products consisting of oils and PAHs would precipitate out of the gas suspension, collect in the bottom of the gas holder tanks, and infiltrate into adjacent soils. The location of the gas holder tank, in addition to a series of smaller tanks can be seen in the northwest portion of Figure 1-1. As evidenced at this site these gas holders were usually partially buried within the soils.

MGP operations also generated a waste fluids stream containing an emulsion of oils, PAHs, and water. This emulsion would be sent to a water/oil separator to recover the oils and discharge the water to a drying pond or nearby water body. The separator worked by slowing the flow of the mixture which in turn allowed the oils and PAHs to float to the top where they were removed with a skimmer and recycled or sold depending upon the quality and/or the local demands for such mixtures. The water portion of this waste stream was discharged to local water bodies. Historically there were problems associated with incomplete separation of the emulsion. In general carbureted water-gas plants were universally known to have chronic problems with the separation process **2** and that the waste water containing oils and PAHs were typically discharged into streams with some of the oils depositing on the banks of the stream **3**.

A plant design drawing dated April 28, 1941 revealed that in the past plant waste water was discharged to the Cooper River via a pipe at a location corresponding to the pre-1940 shoreline **4**. It is of significance to note that prior to 1940 the Cooper River shoreline was located immediately east of Concord Street. The shoreline was later extended to the east between 1941 and 1942 with the addition of fill material, an action which created the present day property currently owned by the NPS. The routing of this discharge pipe would have placed the point of release in the general area of what is now the northwest corner of the NPS property.

1 Draft Final Remedial Investigation Report, Calhoun Park Area Site, Volume 1, dated September 1996, page 1-5.

2 U.S. Production of Manufactured Gases: Assessment of Past Disposal Practices, EPA/600/2-58/012, dated February 1968, pages 136-139.

3 U.S. Production of Manufactured Gases: Assessment of Past Disposal Practices, EPA/600/2-58/012, dated February 1968, pages 65-69,

4 MGP Engineering Drawing, dated February 1, 1936. Revised April 28, 1941.

2.3 Previous Investigations and Containment Measures

Prior to the RI, several investigations had been preformed on the various portions of the properties associated with this site. These individual investigations covered a variety of separate topics including air quality in the crawl space and apartment interiors of Ansonborough Homes, analysis of soil and groundwater samples collected from Calhoun Park and Ansonborough Homes, organic and inorganic analysis of surface water and sediment samples collected from the Cooper River.

During this time a Site Screening Investigation was completed by SC DHEC on June 2, 1992 on the site to gather the necessary information required to prepare the Hazard Ranking System (HRS) package. Based upon the results of this investigation, the site received a HRS score of 48.9 due primarily to the human food chain threat **5**. Listing the site on the National Priorities List (NPL) has been suspended based on the present cooperation by SCE&G in performing the required site activities.

On January 22, 1993, SCE&G entered into an AOC with EPA to perform a Remedial Investigation **6**. To the extent possible data from previous investigations were used for planning the comprehensive sampling approach seen in the Remedial Investigation. The RI was also designed to sample additionally properties such as Ludens, NPS property, Campsen property, Dockside Condominiums, and the Deyton property which had not been sampled to date.

SCE&G retained Fluor Daniel GTI of East Pittsburgh, PA to conduct the work required to complete the RI/FS process. EPA and SC DHEC provided oversight of work conducted during the RI/FS. A complete listing of the documents generated during the RI/FS process can be found in the Index to the Administrative Record for this site. This ROD is intended to summarize key information from the Administrative Record and provide the rationale for the selected response action specified in Section 9.0. The reader is referred to the site Administrative Record for a more detailed account of the information presented in this document.

5 PREscore 1.0 - HRS Documentation Record, Calhoun Park/Ansonborough Homes/Coal Gas, 6/10/92.

6 Administrative Order on Consent, dated January 22, 1993,

Three additional investigations were also performed concurrent with the RI and later came to influence the RI activities. These included the Killam Report, the PSI Report, and the Aquarium Containment Plan. During the early stages of the RI EPA had planned to investigate the NPS property under a separate investigation. Meanwhile both the City of Charleston and the NPS were performing separate investigations on this property concurrent with the RI. These reports were titled the South Carolina Aquarium Site Investigation Results **7** and the Site Inspection Charleston Harbor Site **8** respectively. Data from these two reports were later included into the RI and also used in support of risk assessment calculations.

The general area within the City of Charleston where the site is located has been, and continues to be, subject to aggressive construction efforts. Regulatory concerns over the planned construction of a City aquarium on a contaminated portion of the site owned by the NPS led to the creation of a containment plan. Ultimately this containment plan was implemented to minimize potential discharges of contaminants from the construction activities associated with the aquarium. The containment system as implemented consisted of a sand blanket to minimize resuspension of contaminated sediments, a timber lagging wall to limit discharge of particulates to the subtidal area, and a silt curtain to contain sand from the sand blanket which might be disturbed during construction. Following the completion of the subtidal construction activities a demonstrations report was generated which documented the effectiveness of the containment system.

During the RI the City of Charleston began work to relocate an old storm drain which traversed a portion of the site. Because a portion of the storm drain traversing the site was constructed of brick with deteriorating mortar joints it was acting in part as a groundwater collection system. Storm water from off site properties, and portions of the site groundwater which infiltrated the deteriorating pipe, was discharged into the Cooper River. In order to mitigate this effect, and to prevent the gravel bed required for the replacement pipe from acting in a similar manner, sheet piling was installed between the contaminated shallow aquifer and the location of the new pipe. A groundwater monitoring plan was also established to monitor the effectiveness of the sheet piling in preventing the future infiltration of contaminated groundwater in this area.

A second sediment containment system was later installed on another portion of the NPS property in support of the construction of a tour boat dock. This second containment system, located south of the aquarium containment system, was designed to address contaminated sediments present at the point where the old storm drain discharged into the Cooper River.

The investigations and containment measures associated with both the aquarium construction and the storm drain were addressed during the early stages of the RI. During the completion of the IR an oily sheen was observed on the surface of the Cooper River. This sheen was traced to seeps along the banks of Cooper River at end of Charlotte Street. The seeps were observed to be discharging a oily tar substance with the lighter fractions floating to the surface of the Cooper River while the heaver portions were observed flowing underwater towards the river channel. Two actions were initiated by SCE&G. The first consisted of the installation of a floating boom to contain the oily sheen floating on the surface. The second action consisted of investigating the source of the material contributing to the seeps. These activities have since been documented in a report titled Charlotte Street Investigation Report **9**. The mitigation of the source area responsible for these seeps, the contaminated sediments resulting from the seeps, and sediment contamination documented in the RI will be addressed in a separate ROD for this site. On May 13, 1998 SCE&G signed a removal AOC which addresses an interim action on these seeps. This interim action is currently underway to mitigate the discharge from these seeps.

7 South Carolina Aquarium Site Investigation Reports, Killam Associates, dated December 1994.

8 Site Inspection Charleston Harbor Site, PSI Inc., dated April 1994.

9 Charlotte Street Investigation Report, dated December 1997.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

In May 1995, EPA issued a fact sheet to local citizens and public officials announcing the initiation of RI/FS activities at the site. Concurrent with the release of this fact sheet, the Final RI/FS Work Plan documents were submitted for public review to the information repositories located at EPA's office in Atlanta, GA and the Charleston County Main Library in Charleston, SC. On May 1995, EPA held an RI Kick-Off Public Meeting at the Charleston Public Works Building in Charleston, SC to provide a description of the Superfund process, the work to be performed, and to answer any questions regarding the site.

In January 1998, EPA released a public fact sheet to provide the public with a summary of the findings of the RI and the human health Baseline Risk Assessment. A public information session was held on January 20, 1998, to discuss the information presented in this fact sheet and to answer site specific questions from the public. During March 1998, EPA released the proposed plan public fact sheet which presented the proposed remedial action and also recapped the RI and Baseline Risk Assessment finding. The Final RI Report, Final Human Health Baseline Risk Assessment (BRA), and other site related documents were assembled in an Administrative Record (AR) and submitted to the information repositories for public review concurrent with the release of the fact sheet.

A notice to area citizens regarding the proposed plan public meeting, the location of the local information repository, and the initiation of a 60-day public comment period was published in Charleston's daily newspaper, The Post and Courier, on March 1998. Due to public interest and explicit requests expressed during the previous public information session, the public comment period was opened for 60 days from March 16, 1998, to May 15, 1998. The proposed plan public meeting was held on March 16, 1998, at the Charleston Public Works Building and was attended by approximately 50 people. At the request of local area residents an additional public information session was held on April 28, 1998, to discuss risk assessment issues and groundwater conditions.

Public comments were received during the 60 day comment period. Each specific comment, in addition to EPA's specific response to these comments, is provided as an attachment to this ROD titled as "Responsiveness Summary". A transcript of the March 16, 1998, public meeting and a copy of all comments received during the 60-day public comment period have been provided as an attachment to this ROD.

4.0 ADDITIONAL EARLY RESPONSE ACTIONS

Previous early response actions, in the form of sediment containment measures, have been taken at this site and are described in section 2.3. Additional actions are also planned for contaminated soils and seeps at Charlotte Street and are currently being addressed under a Removal AOC. The rationale for this additional early response is two fold. The City of Charleston will soon begin construction of the parking garage which when built would cover a large portion of contaminated soils associated with this site. In order to remove the soils while still accessible, and to minimize exposure risk to the on-site construction workers, the contaminated soils will be removed prior to beginning the garage construction. Additionally the seeps located along the end of Charlotte Street have been discharging coal tar waste into Cooper River since November 1997. As such, a response action was deemed necessary,

According to the Removal AOC, which became effective May 22, 1998, the work to be performed will be as follows:

- Delineation, excavation, and disposal of contaminated soils as presented in the Calhoun Park Feasibility Study dated November 1997, to a depth of 3 feet below land surface and having an estimated volume of approximately 6,080 cubic yards;

- Further investigation and prevention or mitigation of the discharge of coal tar into the Cooper River from seeps along Charlotte Street.

5.0 SUMMARY OF SITE CHARACTERISTICS

This section provides a brief and concise overview of the site characteristics as assessed during the site RI. The majority of the field activities performed by SCE&G as presented in the

R I were performed between November 1993 and January 1994. As previously mentioned there were two additional investigations performed concurrent with the RI and the information eventually assimilated into the RI report. These investigations consisted of the Killam Report and the PSI Report. Collectively these field investigations generated a voluminous data base. The results of these field programs and appropriate conclusions have been presented in the following technical reports that are incorporated into the site Administrative Record:

- Draft Final, Remedial Investigation Report, Calhoun Park Area Site, Volumes 1 & 2, Fluor Daniel GTI (September 1996)

- Feasibility Study, Calhoun Park Area Site, Fluor Daniel GTI (November 1997) South Carolina Aquarium Site Investigation, Killam Assoc, (December 1994)

- Site Inspection Charleston Harbor Site, PSI Inc. (April 1994)

In the interest of brevity, the information presented in the above reports is not re-iterated in this decision document. Rather, the conclusions of the RI are presented in a more qualitative summary format to provide the reader with an overview. Specific human health risks posed by the site constituents are summarized in Section 6.1. Cleanup goals for all media addressed by this response action are delineated in Section 7.1. The reader should refer to the site Administrative Record for a more detailed account of this subject matter.

5.1 Physical Characteristics

This section provides a summary of information regarding the physical characteristics of the site including demography, meteorology, topography, surface water hydrology, and geology/hydrogeology.

5.1.1 Demography

The site is located in the downtown area of Charleston, South Carolina. Current land use for the site, and adjacent properties consists of a mixture of commercial and light industrial operations interspersed with pockets of residential areas. According to a document titled Calhoun Street Corridor, prepared in 1989 by the City of Charleston planning commission, plans are underway to construct a parking garage on the current Calhoun Park property. Additional commercial development is planned for portions of the NPS property, the Campsen property, and portions of the property previously occupied by the Ansonborough Homes.

5.1.2 Meteorology

The climate in Charleston, SC is temperate and modified considerably by the proximity to the Atlantic Ocean. The marine influence is noticeable during winter when the low temperatures are sometimes 10-155F higher on the peninsula than areas ten miles inland. Likewise, summer high temperatures are generally a few degrees lower than inland areas. The average daily maximum temperature ranges from 90.2 5F in July to 57.8 5F in January. The average daily minimum temperature ranges from 72.7 5F in July to 37.7 5F in January. Prevailing winds are northerly in the fall and winter, and southerly in the spring and summer. The average precipitation ranges from 8 inches or more in July to 3 inches or less in November. Late summer and early fall is the period of maximum threat to the South Carolina coast from hurricanes.

5.1.4 Surface Water Hydrology

Much of Charleston County is tidal estuary, including the area in which the site is located. The Charleston Harbor and the Cooper River are tidally influenced and have a semidiurnal tide which averages 5.2 feet. The Cooper River borders the site to the east. The site lies above normal high tide levels with the exception of localized tidal flooding of the storm drain grates in the Ansonborough Homes area to the south and portions of Charlotte Street to the north. The 50-year storm surge level for Charleston County is 11 feet above Mean Sea Level (MSL). A storm surge to this elevation would cause complete flooding of the site.

Surface water drainage at this site occurs as either overland flow or through a series of storm water collection piping. While the old underground brick archway mentioned in section 2.3 no longer exists, it did transect a portion of the site for a number of years and influenced both surface water and groundwater hydrology. The old brick archway ran due east along Calhoun Street collecting the majority of storm water from the site. This water was eventually discharged into the Cooper River. Historically the old brick archway terminated immediately east of the intersection of Calhoun Street and Concord Street as the fill material comprising the NPS was not in place until 1941. Following the addition of the fill the brick archway was then extended so that it could continue to discharge water into the Cooper River.

5.1.5 Geology/Hydrogeology

The site is located in the discharge portion of the Atlantic Coastal Plain physiographic province. The Cooper Marl clay formation, a regional confining unit approximately 260 feet thick, is encountered at depths on-site ranging from 68 to 85 feet below land surface (BLS). The RI was limited to characterizing the shallow aquifer above the Cooper Marl confining unit.

Three water-bearing units (shallow, intermediate, and deep sands) and two lower permeability units (shallow and intermediate clays) were identified in the shallow aquifer above the Cooper Marl. A representative stratigraphic model of the site is presented graphically in Figure 5-1. From the land surface to the top of the Cooper Group, the stratigraphic units beneath the site are 1)artificial fill; 2)upper clay; 3)intermediiate sands; 4)intermediate clay; 5)lower sands; and 6)the Cooper Group. The presence and thickness of these layers vary across the site.

As seen in the stratigraphic cross-sections, the site is covered with a layer of fill which contains sand, silt, shells, gravel, including wood scraps and building rubble. The fill varies in thickness between 4 to 15 feet bls and has an average hydraulic conductivity of 6.1×10^{-3} cm/sec. The water table stands within this unit at approximately 2 to 4 feet b1s. The "A"-level wells and piezometers, are located within this unit. The fill unit is underlain by an upper clay unit which begins between 5 to 20 feet bls and extends to between 30 to 40 feet bls. In general the upper clay unit serves as a unit of lower permeability with an average hydraulic conductivity of 3.4×10^{-7} cm/sec, however, the presence of course grain particles and hydraulic data suggest that appreciable leakage may occur though this upper clay in some areas. As an additional note the upper clay layer within the general vicinity of the electrical substation was likely breached during the installation and/or removal of the gas holder.

Beneath this uppermost clay layer exists an intermediate sand/silt layer which is encountered between 30 to 40 feet and extends to 50 to 65 feet bls. This unit is a water bearing zone with an average hydraulic conductivity of 5.6×10^{-3} cm/sec. The intermediate sand/silt layer is underlain by an intermediate clay layer which is encountered between 50 to 65 feet extending to 60 to 75 feet bls. This clay layer serves as a unit of lower permeability where present, however, it is not present as a distinct clay zone across the entire site. Where present the average hydraulic conductivity is 2.1×10^{-8} cm/sec.

A lower sand/silt unit is found beneath the intermediate clay layer, encountered between 55 to 75 feet bls and extending to 60 to 85 feet bls before encountering the Ashley Formation. The average hydraulic conductivity of the lower sand/silt unit is 5.6×10^{-3} cm/sec. The Ashley Formation is located beneath the lower sand/silt unit and is located between 68 to 85 feet bls. This formation consists of a dense calcareous sand and has an average hydraulic conductivity of 1.7×10^{-7} cm/sec. The intermediate sand and lower sand unit may possibly be used locally within Charleston County as a water supply, but no known shallow groundwater wells are in use within a four mile radius of the site. Drinking water to this area is supplied by the City of Charleston.

5.2 Nature and Extent of Impact

The media investigated as part of the RI included soils, groundwater, and surface water/sediments. The sampling locations are presented in Figures 2-2, 2-3, & 2-4. The following sections briefly discuss each media sampled and the corresponding contamination present at the sampling locations.

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5.2.1 Surface/Subsurface Soils

Impact of the site to surface soils (defined as 0 to six inches BLS) and subsurface soils (soils 6 inches or greater BLS) were characterized by the collection of soil borings. Generally, this effort included the collection of samples from areas likely impacted by past operations. These potential source areas of interest included the gas holder area, the relief holder area, and the rosin wood treating operation (Fernoline Chemical). Samples were also collected throughout other areas of the site. The sampling locations are illustrated in Figure 5-2.

The majority of contaminants impacting the soils at this site consist primarily of volatile and semi-volatile organic compounds. The majority of the semi-volatile organic compounds consist of PAHs, primarily Acenaphthene, Acenaphthylene, Anthracene, Benzo(G,H,I)perylene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene, Pyrene, Benzo(A)anthracene, Benzo(A)pyrene, Benzo(B)fluoranthene, Benzo(K)fluoranthene, Chrysene, Dibenz(A,H)anthracene, and Indeno(1,2,3-CD)pyrene. The group of volatile organic compounds present are primarily the BTEX group (benzene, toluene, ethylbenzene, and xylene).

The areas most impacted by contaminants include the gas holder, the relief holder, and soils surrounding the waste disposal pipe. Another concentrated area of contamination was identified at the northwest corner of Ludens property. Contaminant concentration ranges are presented in Table 5-1. Both the PAH and BTEX groups are commonly associated with contamination present at manufactured gas plants.

5.2.2 Groundwater

Shallow Sand Aquifer

Evaluation of the extent of groundwater contamination was focused primarily on the fill aquifer as evidenced by the 32 shallow "A" wells installed across the site. The primary contaminants present in the fill aquifer consist of the BTEX group, the PAH group, and several inorganic compounds. Organic contaminants in the fill aquifer exceeding the MCLs include Benzene, 2,4-Dimethylphenol, Benzo(a)pyrene, Benzo(A)anthracene, Benzo(B)fluoranthene, Benzo(K)fluoranthene, Chrysene, Indeno(1,2,3-CD)pyrene, Ethyl benzene, Carbazole, Chrysene, Naphthalene, and Toluene. Inorganic contaminants exceeding the MCLs include Arsenic Cyanide, Beryllium, Lead, Mercury, Chromium, Nickel, and Copper. Isoconcentration maps for selected groundwater contaminant plumes are presented in Figures 5-4, 5-5, & 5-6. These maps provide a general indicator as to the extent of groundwater contamination associated with this site which exceed MCLs. As evidenced from these maps, portions of the contaminated groundwater plume are discharging into the Cooper River. Contaminant concentration ranges are presented in Table 5-2.

Table 5-1
Chemicals Detected in greater than 5% of Soil Samples

Chemical	Frequency of Detection (1)	Range of Detection (mg/kg)	Average Concentration(2) (mg/kg)	Mean Background Concentration (2) (mg/kg)	Region III Screening Values (3) (mg/kg)
VOLATILE ORGANICS					
Acetone	22/53	0.02 - 2	0.48	0.16	10000
Carbon Disulfide	5/53	0.003 - 0.04	0.02	0.03	10000
2-Butanone	12/53	0.008 - 0.15	0.05	ND	61000
Benzene	13/53	0.02 - 43	4.8	ND	99
Toluene	10/53	0.004 - 100	15	ND	20000
Ethylbenzene	13/53	0.017 - 110	23	ND	10000
Xylenes	9/53	0.013 - 150	24	ND	100000
BASE NEUTRAL ORGANICS					
Dibenzofuran	20/53	0.04 - 9	1.5	ND	NA
Di-n-butylphthalate	3/53	0.05 - 2	0.60	ND	780
Carbazole	15/53	0.023 - 3	0.05	0.09	140
Bis(2-ethylhexyl)phthalate	8/53	0.035 - 6	0.99	0.08	200
PAHs					
2-Methylnaphthalene	29/53	0.041 - 9	7.8	ND	NA
Acenaphthene	19/53	0.053 - 26	3.5	ND	6100
Acenapthylene	32/53	0.029 - 69	4.4	ND	NA
Anthracene	42/53	0.024 - 37	3.0	0.05	31000
Benzo(g,h,i)perylene	39/53	0.034 - 17	2.3	0.51	NA
Fluoranthene	51/53	0.030 - 52	6.8	0.97	4100
Fluorene	25/53	0.053 - 59	6.4	ND	4100
Naphthalene	34/53	0.051 - 160	13.6	ND	4100
Phenanthrene	48/53	0.046 - 140	10	0.50	NA
Pyrene	48/53	0.042 - 69	8.2	0.88	3100
Benzo(a)anthracene	49/53	0.037 - 38	4.2	0.38	3.9
Benzo(a)pyrene	48/53	0.049 - 28	3.7	0.53	0.39
Benzo(b)fluoranthene	47/53	0.034 - 30	4.5	0.78	39
Benzo(k)fluoranthene	44/53	0.030 - 16	2.2	0.41	39
Chrysene	49/53	0.050 - 35	4.1	0.57	390
Dibenz(a,h)anthracene	29/53	0.021 - 6	1.0	0.11	NA
Indeno(1,2,3-cd)pyrene	45/53	0.025 - 17	2.7	0.54	3.9

INORGANICS					
Antimony	7/53	8.1 - 36	15	ND	41
Arsenic	47/53	3.3 - 250	24	13	1.6
Barium	35/53	47.6 - 1060	204	288	7200
Beryllium	5/53	1.2 - 3.4	2.0	ND	0.67
Cadmium	6/53	1.6 - 9.7	3.4	ND	51
Chromium	53/53	3.3 - 150	18	21	510
Copper	50/53	8.7 - 496	94	58	3800
Cyanide	31/53	0.67 - 601	45	ND	2000
Lead	53/53	10.2 - 3530	397	824	NA
Manganese	53/53	14.1 - 1390	154	94	510
Mercury	29/53	0.12 - 14	1.4	2.8	31
Nickel	20/53	9.6 - 113	26	ND	2000
Selenium	14/53	1.7 - 15.5	4.8	ND	510
Thallium	3/53	1.2 - 9.2	5.8	ND	NA
Vanadium	37/53	12.2 - 75	23	37	720
Zinc	52/53	15.2 - 1600	270	506	31000

NA-Not Available
ND-Not Detected

Table 5-2
Chemicals Detected in greater than 5% of Soil Samples

Chemical	Frequency of Detection (1)	Range of Detection (ug/L)	Average Concentration(2) (ug/L)	Mean Background Concentration (2) (ug/L)	Region III Screening Values (3) (ug/L)	MCL Values (4) (ug/L)
VOLATILE ORGANICS						
Acetone	6/32	6 - 17	11	ND	370	NA
Benzene	14/32	6 - 5200	571	ND	0.36	5
Toluene	12/32	2 - 1800	214	ND	75	1000
Ethylbenzene	14/32	2 - 1200	200	ND	130	700
Xylenes	13/32	4 - 1800	280	ND	1200	10000
BASE NEUTRAL ORGANICS						
Phenol	3/32	8 - 150	58	ND	2200	NA
2-Methylphenol	3/32	1 - 400	197	ND	180	NA
4-Methylphenol	2/32	240 - 620	430	ND	18	NA
2,4-Dimethylphenol	2/32	180 - 890	535	ND	73	NA
Dibenzofuran	16/32	3 - 140	40	ND	NA	NA
Carbazole	13/32	0.8 - 150	49	ND	3.4	NA
Bis(2-Ethylhexyl)phthalate	3/32	1 - 22	8.0	ND	4.8	NA
PAHs						
2-Methylnaphthalene	17/32	1 - 1100	157	ND	NA	NA
Acenaphthene	21/32	1 - 370	66	ND	220	NA
Acenaphthylene	11/32	0.6 - 140	23	ND	NA	NA
Anthracene	19/32	0.5 - 210	34	ND	1100	NA
Benzo(g,h,i)perylene	7/32	0.8 - 10	2.7	ND	NA	NA
Fluoranthene	21/32	1 - 410	52	ND	150	NA
Fluorene	20/32	0.6 - 290	48	ND	150	NA
Naphthalene	21/32	0.7 - 5500	782	ND	150	NA
Phenanthrene	23/32	0.8 - 970	108	2.0	NA	NA
Pyrene	21/32	1 - 480	51	ND	110	NA
Benzo(a)anthracene	13/32	0.8 - 180	29	ND	0.092	NA
Benzo(a)pyrene	8/32	1 - 38	9.1	ND	0.0092	0.2
Benzo(b)fluoranthene	13/32	1 - 130	23	ND	0.092	NA
Chrysene	11/32	2 - 160	31	ND	9.2	NA
Indeno(1,2,3-cd)pyrene	7/32	0.9 - 12	3.1	ND	0.092	NA

INORGANICS						
Arsenic	21/32	4 - 88	23	25	0.04	50
Barium	21/32	203 - 1470	487	47	260	2000
Beryllium	2/32	6 - 13	9.3	ND	0.016	4.0
Chromium	21/32	28 - 130	35	ND	18	100
Copper	10/32	8 - 5080	567	7.3	140	1300*
Cyanide	14/32	11 - 4480	832	ND	73	200
Lead	17/32	3 - 1920	322	52	NA	15
Manganese	32/32	178 - 3050	959	366	18	50**
Mercury	27/32	0.2 - 15	3.5	0.5	1	2.0
Nickel	7/32	41 - 304	110	ND	73	100
Vanadium	8/32	56 - 174	91	10	26	NA
Zinc	25/32	26 - 2610	678	81	1100	5000**

NA-Not Available
ND-Not Detected
*-Maximum Contaminant Level Goal

(1) Sampling date was January 1994.
(2) Average of detects only used when calculating average and background concentrations.
(3) These values were obtained from EPA Region III Risk based concentrations technical guidance for selecting chemicals of potential concern. All values are based on a carcinogenic risk of 1E-06 and noncarcinogenic hazard index of 0.1. EPA Region III screening values are based on a hazard quotient of 1.0 for noncarcinogenic compounds. However, in accordance with Region IV guidance, the concentrations of noncarcinogenic compounds shown in the Region III tables have been adjusted by a factor of 0.1 to reflect a concentration that would produce a hazard quotient of 0.1. The values listed represent tapwater criteria.
(4) Maximum Contaminant Level (MCL)

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Intermediate and Deep Sand Aquifers

Groundwater samples were collected from eleven intermediate and deep wells, designated "B" and "D" respectively. The locations of these wells can be seen on the soil sampling map designated as Figure 5-2. Constituents present in these wells include both BTEXs and PAHs, some of which were present in concentrations in excess of MCLs. No plume maps were presented for either of these aquifers due to the relatively small number of data points taken. Because the extent of contamination within these aquifers were not well defined during the Remedial Investigation, additional evaluation will be performed as part of the remedial design to determine if additional cleanup actions are warranted.

Analytical results from all monitoring wells were compared to Maximum Contaminant Levels (MCLs) which have been established to be protective of human health based on the use of site groundwater as a drinking water source. This comparison is conservative given that the water-bearing units do not have sufficient capacity and that the groundwater near the Cooper River is either saline or brackish, MCL exceedances were noted in either the shallow and/or intermediate water-bearing units for the following constituents: Arsenic, Cyanide, Benzene, 2,4-Dimethylphenol, Benzo(a)pyrene, Ethylbenzene, Beryllium, Lead, Mercury, Chrysene, Naphthalene, Chromium, Nickel, and Copper. Contaminant concentration ranges are presented in Table 5-3.

An artesian well, designated as sample MG-01M, was also sampled as part of this investigation. Low levels of PAHs were detected within this well but were below their corresponding MCLs. Dioxin sampling was also performed on the following three wells: BM-01A (background), AM-04A (Ansonborough Homes), and CPMW-3 (Calhoun Park). While eight of the PCDD/PCDF congeners were detected in the two on-site wells, examination of the 2,3,7,8-TCDD Toxicity Equivalent Concentrations revealed that the concentrations present (<2 pg/l) were below the MCL of 30 pg/l.

5.2.3 NAPLs

The following discussion is limited to the NAPL investigation as presented in the RI/FS. Shortly following the completion of the RI/FS, coal tar was observed discharging from seeps near the north east portion of the site (see section 2.3 Containment Measures). Subsequent investigative work has revealed the presence of additional NAPL source areas, other than the ones discussed in the RI/FS, which are attributable to the MGP operations. As of the writing of this ROD additional investigative work is currently underway to determine the extent of these source areas and evaluate appropriate remedial actions.

NAPLs comprise a broad class of compounds which are immiscible fluids with densities greater than water (DNAPLs), including PAHs, or lighter than water (LNAPLs).

Table 5-2
Contaminant Concentration Ranges
than 5% of Soil Samples

Chemical	Frequency of Detection (1)	Range of Detection (ug/l)	Average Concentration(2) (ug/l)	Mean Background Concentration (2) (ug/l)	Region III Screening Values(3) (ug/l)	MCL Values(4) (ug/l)
VOLATILE ORGANICS						
Methylene Chloride	1/11	17	17	ND	4.1	5
Acetone	1/11	11000	11000	ND	370	NA
Chloroform	1/11	37	37	ND	0.15	NA
Benzene	5/11	3 - 15000	4981	ND	0.36	5
Toluene	2/11	160 - 490	325	ND	*75	1000
Ethylbenzene	3/11	250 - 3600	1540	ND	130	700
Xylenes	4/11	6 - 2500	804	ND	1200	10000
BASE NEUTRAL ORGANICS						
Phenol	5/11	0.9 - 91	45	ND	2200	NA
2-Methylphenol	1/11	12	12	ND	180	NA
4-Methylphenol	1/11	37	37	ND	18	NA
2,4-Dimethylphenol	1/11	130	130	ND	73	NA
Dimethylphthalate	1/11	17	17	ND	37000	NA
Dibenzofuran	2/11	2 - 28	15	ND	NA	NA
Diethylphthalate	1/11	34	34	ND	2900	NA
Carbazole	2/11	3 - 81	42	ND	3.4	NA
PAHs						
2-Methylnaphthalene	2/11	210 - 370	290	ND	NA	NA
Acenaphthene	3/11	0.9 - 42	16	ND	220	NA
Acenaphthylene	2/11	26 - 62	44	ND	NA	NA
Anthracene	2/11	3 - 9	6.0	ND	1100	NA
Fluoranthene	2/11	2 - 12	7.0	ND	150	NA
Fluorene	2/11	16 - 54	35	ND	150	NA
Naphthalene	6/11	3 - 3400	699	ND	150	NA
Phenanthrene	3/11	0.8 - 44	21	2.0	NA	NA
Pyrene	2/11	2 - 9	5.5	ND	110	NA
Benzo(a)anthracene	1/11	2	2.0	ND	0.092	NA
Benzo(a)pyrene	1/11	1	1.0	ND	0.0092	0.20
Benzo(b)fluoranthene	1/11	1	1.0	ND	0.092	NA
Chrysene	1/11	2	2.0	ND	9.2	NA

INORGANICS						
Chromium	8/11	13 - 68	30	ND	18	100
Cyanide	7/11	11 - 173	84	ND	73	200
Manganese	7/11	32 - 334	143	366	18	50*
Nickel	2/11	43 - 61	52	ND	73	100

NA-Not Available
ND-Not Detected

(1) Sampling date was January 1994.
(2) Average of detects only used when calculating average and background concentrations.
(3) These values were obtained from EPA Region III Risk based concentrations technical guidance for selecting chemicals of potential concern. All values are based on a carcinogenic risk of 1E-06 and noncarcinogenic hazard index of 0.1. EPA Region III screening values are based on a hazard of 1.0 for noncarcinogenic compounds. However, in accordance with Region IV guidance, the concentrations of noncarcinogenic compounds shown in the Region III tables have been adjusted by a factor of 0.1 to reflect a concentration that would produce a hazard quotient of 0.1. The values listed represent tapwater criteria.
(4) Maximum Contaminant Level (MCL)

Therefore, EPA adhered to the groundwater/NAPL site characterization strategy presented in EPA OSWER Directive 9234.2-25, Guidance for Evaluating the Technical Impracticability of Groundwater Restoration (EPA 1993). This guidance document advocates a strategy which delineates three areas: 1) the NAPL entry location; 2) the NAPL zone or source area; and 3) the aqueous contaminant plume. The entry locations are those areas where NAPL may have entered the environment and, therefore, is likely present in the subsurface. The NAPL zone or source area is defined by that portion of the subsurface containing free-phase or residual NAPL. The aqueous contaminant plume contains dissolved phase constituents down gradient from source areas. The RI field program focused on likely entry zones by utilizing information gathered on historical operating procedures for the MGP. NAPL source areas and dissolved phase constituent plumes were delineated through the installation of monitoring wells.

The general locations where measurable thicknesses of DNAPLs were observed during the RI include wells CPMW-3, MM-01A, MM-02B, and MZ-06A. Wells MM-01A and MM-02B contained NAPLs layer greater than 0.5 feet. Additionally wells CM-05A, MZ-05A, and MW-12, were observed as having visual traces of NAPLs. Consequently the occurrence of NAPL as reported in the RI can be grouped around the MGP; more specifically the former gas holder, the former rail spur, and the former oil tanks. These areas constitute both the NAPL entry location and the NAPL zone or source area. While NAPL was present primarily within the shallow aquifer, it was also observed in well MM-02B which is located within the intermediate sand aquifer in the area adjacent to the gas holder.

5.2.4 Sediments

The following information is provided as an overview of the general sediment conditions at the close of the RI/FS. With the recent release of coal tar via seeps into the Cooper River, a new source of sediment contamination has occurred. Interim measures are presently underway to stop this discharge. The extent of contamination associated with this release is under investigation and will ultimately impact any future plans for remediating the sediments. A second ROD will be issued to address the sediments once the sediment investigation is complete.

The nature and extent of impact to the benthic community within the Cooper River was determined by the analysis of seven sediment samples. Additional samples were also collected at the Calhoun Street drain discharge point or outfall, the Calhoun Street manhole, the Hassel Street outfall, and the Columbus Street outfall. The sediment sampling locations are identified in Figure 5-3.

The analytical results were then compared to the relevant ecological screening criteria; NOAA's Effects Range-Low (ERL), Effects Range-Median (ERM) and EPA's Sediment Quality Criteria (for addressing equilibrium partitioning). In summary the data indicates that the primary constituents present in site sediments which exceeds ERLs, ERMs, and EPA's Sediment Quality Criteria would be the PAHs. Inorganic constituents including lead, arsenic, cadmium, and mercury were present in sediment samples in excess of ERLs. With the exception of arsenic which appears in the soils in concentrated areas surrounding the MGP, the remaining inorganic constituents do not appear to be associated with the MGP operations.

Sediment samples which exceeded the screening levels are clustered around two primary areas: the Calhoun Street drain outfall (SD-10) and the area adjacent to the NPS property. The concentration of contaminated sediments adjacent to the NPS property can be readily associated with the previous MGP operation of a discharge pipe as discussed previously in section 2.1 Previous Site Operations.

The contaminated sediments located at the Calhoun Street drain outfall suggest that the drain has acted as a conduit carrying contaminated water and/or sediment into the Cooper River. A comparison of sediment concentrations from stations upgradient (sample SD-11 at corner of Elizabeth St. and Calhoun St.) and downgradient (sample SD-10 at drainage outfall in Cooper River) of the site suggest that the source of contamination entered the drain somewhere between these two sampling points. While the contamination is consistent with the type of contamination associated with MGP operations (i.e. PAHs) an evaluation of the data did not reveal any particular source or sources responsible for this contamination because the construction of the drain pipe was such that it received water not only from the street storm grates but also from adjacent groundwater which infiltrated the pipe due to decaying mortar joints.

Ecological Assessment

An ecological assessment was performed on a portion of the Cooper River adjacent to the site. This assessment consisted of an investigation on benthic macroinvertebrates to evaluate their individual abundance as well as their number and types against a background location. A summation of the findings at the close of the RI/FS indicated that there were no significant differences between the on site stations versus the off site stations. This conclusion was based on conditions at the close of the RI/FS and prior to the recent release of coal tar via seeps into the Cooper River. This recent release represents an additional contaminant source potentially threatening ecological receptors. The effect of this source area will be evaluated during the sediment investigation and discussed under the same ROD as the sediments.

5.2.5 Surface Water

The following information is provided as an overview of the general surface water conditions at the close of the RI/FS. With the recent release of coal tar via seeps into the Cooper River, a new source of surface water contamination has occurred and additional investigative work is underway. Following completion of this ongoing investigation a second ROD will be issued to address surface water/sediment contamination on human health and the environment.

Surface water samples were collected from floodwater surrounding Ansonborough Homes, Cooper River surface waters, and three storm water outfalls. BTEX, SVOCs, and PAHs were detected at the point where the Calhoun Street drain outfall enters the Cooper River (SW-10). Additionally dioxins were detected in surface water samples collected from the Cooper River and the Calhoun Street drain. These results were compared to U.S. EPA acute and chronic Ambient Water Quality Criteria (AWQC). While surface water contamination was present in surface waters surrounding the site, the concentrations of these contaminants did not exceed the AWQC standards. These same contaminants were also present in low levels throughout the study area, including some of the background locations. While there was no significant threat from surface water contamination to humans from this site at the close of RI, the recent release of contamination via seeps will require additional investigation as mentioned in the preceding paragraph.

6.0 SUMMARY OF SITE RISKS

The human health baseline risk assessment process provides the basis for taking action and identifies contaminants and the exposure pathways that need to be addressed by the remedial action. It estimates what risks the site poses if no action were taken. This section of the ROD summarizes the results of the human health baseline risk assessment for this site. Environmental risks are presently unresolved due to the on-going discharge of coal tar from seeps as discussed in section 4. The environmental risks resulting from these seeps, in addition to the overall environmental risk associated with this Site, will be evaluated under operable unit two and addressed in a second ROD for this site.

The evaluation of human health risk associated with this site is discussed within three documents present in the Administrative Record: the Baseline Risk Assessment by Black & Veatch, the Revision to Risk Assessment written by EPA, and the Assessment of Risk for NPS which was also written by EPA. Typically the site risk is presented under one document and titled as the Baseline Risk Assessment. A discussion as to why these three documents are pertinent in assessing site risk is offered in the following paragraphs.

Initially the baseline risk assessment document was submitted to EPA in a draft format on August 1994 with a revision submitted on October 1994 which was accepted as a final version. EPA then discovered several errors which remained in this document. To address these errors EPA generated the Revision to Risk Assessment dated July 1996. Meanwhile the Killam Report and the PSI Report were generated. Following a review of these two data sets, EPA initially decided to evaluate the data separate from the RI data, and present the results in the document titled "Assessment of Risk at the National Park Service Property, December 11, 1995." This decision was based on two considerations: the highly skewed sample locations, and that these soils would be removed during the aquarium construction. The same exposed populations were examined, i.e., current trespassers, future construction workers, and future residents, for contaminated soils. In general the contaminant levels, specifically inorganics, PAHs and PCBs were found in higher concentrations in the ESI/Killam reports than in the RI.

During the Feasibility Study EPA expanded this risk assessment strategy and required that all future calculations for Preliminary Remediation Goals (PRGs) evaluate information within all three data sets. As a result the Administrative Record actually contains three sets of PRGs: those in the revised BRA, the Assessment of Risk at the National Park Service Property, and those found in the FS. The PRGs present in the FS are the most representative of the general site conditions and are therefore maintained throughout this ROD. The following discussion provides a generic outline for the processes used in all three documents.

6.1 Human Health Baseline Risk Assessment

The human health risk assessment process consists of the following major components: exposure assessment, toxicity assessment, and risk characterization. The exposure assessment involves the identification of potentially exposed populations and pathways, calculation of media-specific exposure point concentrations from data generated during the RI, and development of assumptions regarding exposure frequency and duration. The toxicity assessment utilizes existing chemical-specific toxicity information to determine the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure and adverse effects. Carcinogenic risks are evaluated by factoring the intake of a chemical with the slope factor for that contaminant. Non-carcinogenic risks are evaluated by comparing the intake of a chemical to the corresponding reference dose of that compound. Risk characterization combines the exposure and toxicity assessments to quantitatively and qualitatively evaluate the potential risks posed. The risk assessment process concludes by the calculation of media-specific cleanup levels that are adequately protective of human health. Cleanup levels are discussed further in Section 7.1 below.

EPA employed a reasonable maximum exposure (RME) approach to estimate the potential exposures and associated risks at the site. The RME is the highest exposure that is reasonably expected to occur at the site and is intended to estimate a conservative exposure case that is still within the range of possible exposures. The exposure pathways evaluated in this assessment included incidental ingestion and dermal contact with surface/subsurface soils, sediments, and groundwater ingestion and inhalation.

EPA evaluated the chemicals detected on-site according to their potential to produce either cancer and/or non-cancer health effects. The carcinogenic risk range EPA has set for Superfund cleanups to be protective of human health is 1 x 10 -4 to 1 x 10 -6. For example, a cancer risk of 1 x 10 -6 indicates that an individual has a 1 in 1,000,000 (or 1 in 10,000 for 1 x 10 -4) incremental chance of developing cancer as a result of site-related exposure to a carcinogen over a 70 year lifetime under the specific exposure conditions at the site. EPA generally uses the cumulative benchmark risk level of 1 x 10 -4 for all exposures relating to a particular medium to trigger action for that medium. In other words, a carcinogenic risk greater than 1 x 10 -4 for soil would indicate that remedial action for soil is necessary. However, EPA may decide that a risk level less than 10 -6 (i.e., a risk between 10 -4 and 10 -6) is unacceptable due to site-specific conditions and that remedial action is warranted.

Non-cancer exposure estimates were developed using EPA reference doses to calculate a Hazard Index (HI). A HI greater that 1 indicates that constituents are present at concentrations that may produce harmful effects. The resultant carcinogenic and non-carcinogenic risks for the future on-site construction worker, future on-site worker and future on-site resident are provided in Table 6-1.

The principle threat to human health and the environment at this Site is from exposure to contaminated soils and groundwater. This is illustrated by the conceptual site model which traces NAPLs migrating from MGP source areas through unsaturated soils and downward to the groundwater. The migration of NAPLs would continue through the saturated zone until encountering zones of lower permeability. This would result in exposure pathways consisting of contaminated soils in the unsaturated and saturated zones, a dissolved phase groundwater plume, and NAPL source areas.

Potentially exposed populations to these pathways could include both commercial workers and residential populations. Commercial workers are most likely to be exposed to contaminated surface and subsurface soils whereas future residential populations would likely be exposed to contaminated surface soils and groundwater. It should be noted that while both commercial and residential scenarios were evaluated the most likely use of the property is commercial.

TABLE 6-1
LIFETIME CARCINOGENIC AND NON-CARCINOGENIC RISKS
INDUSTRIAL AND RESIDENTIAL SCENARIOS

	Construction Worker		On-Site Long Term Worker		Future Resident (Child)	
Exposure Pathway	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index 1
			Surface Soil			
Incidental Ingestion	4.0e -6	1.1e -1	1.0e -5	5.2e -2	6.2e -5	1.4e +0
Dermal Contact	5.8 -7	7.4 -3	4.9e -6	2.3e -6	8.9e -6	9.4e -2
			Subsurface Soil			
Incidental Ingestion	7.13e -6	3.9e -3	NE	NE	NE	NE
Dermal Contact	1.9e -6	4.8e -4	NE	NE	NE	NE
			Shallow Groundwater			
Ingestion/ Inhalation	NE	NE	NE	NE	1.4e -3	2.3 +2
			Deep Groundwater			
Ingestion/ Inhalation	NE	NE	NE	NE	5.0e -3	6.7e +3
Total Risk	2.4e -5	0.12	1.5 -5	0.075	5.0e -3	6700*

Footnotes:
*Total risk values from exposure to deep groundwater. The total risk from shallow groundwater calculated at 1.4e -3 (carcinogenic) and 230 (non-carcinogenic),
NE - Not evaluated for this receptor.

The evaluation of the commercial workers and future residential populations within these exposure scenarios resulted in unacceptable risk levels from soils and groundwater. As evidenced in Table 1, risks under the construction worker and long term worker scenarios were largely driven by incidental ingestion and/or dermal contact with surface and subsurface soils. The risk to future resident scenario was driven primarily by exposure to groundwater. As footnoted in table one, the total risk values were calculated separately regarding the shallow aquifer and the deep aquifer as it is not expected that a given child would be exposed to both aquifers. The contaminants which contribute significantly to the site risks are PAHs and arsenic.

For this Site, EPA believes that remedial action is warranted based on site-specific conditions discussed above. The following sections evaluates the remedial alternatives considered for this Site and their effectiveness in addressing these principal threats.

7.0 DESCRIPTION OF ALTERNATIVES

The following section provides a summary of the remedial alternatives for soils and groundwater/NAPL that were evaluated in detail in the Feasibility Study Report. All alternative cost estimates are expressed in 1997 dollars and are based on conceptual engineering, design and construction. Total present worth costs include capital costs and operation/maintenance costs to completely finance the remedy over its planned life.

7.1 Development of Cleanup Levels

A Final Feasibility Study was completed in December 1997 to develop and evaluate cleanup alternatives that provide adequate protection of human health. This effort required the derivation of cleanup levels for the media of concern: soils and groundwater/NAPL. Cleanup levels were necessary to identify areas to be addressed by EPA's response action for the site. Based upon City of Charleston zoning plans and expected future commercial land-use in the general site area, EPA has selected soil cleanup levels to be protective of the construction worker under a future commercial land-use scenario. Given the close proximity of the Dockside Condominiums to the site, potential exposure risks to residents were also considered and as such ultimately factored into the final cleanup levels.

In the final analysis the cleanup levels selected are actually protective for both construction workers and future residents. This is possible because the cleanup levels chosen were on the more protective end of the risk range for protecting the future construction workers. As such they also fall within the acceptable range of risk values which would be protective for on-site residents.

7.1.1 Soils

The Remedial Action Objectives (RAOs) for soils are focused on the protection of human health and the protection of groundwater quality. From a human health perspective the RAOs include ensuring that soils exposure concentrations levels are adequately protective for the following scenarios: the future construction worker, the future long term worker, and future residents. The FS developed cleanup levels for soils that were within EPA's protective risk range of 1 x 10 -4 to 1 x 10 -6 for these three scenarios.

The corresponding Preliminary Remedial Goals (PRGs) were presented in the RI and summarized in Table 7-1 . These values were based on data presented in the risk assessment. The PRGs are not the concentrations above which all soils should be remediated. The PRGs are based upon the Upper Confidence Limits [10] (UCL) in the same manner as the risk assessment used UCL in calculating the soil exposure point concentrations for determining overall site risk. Because the UCL were used in calculating the current site risk (3xl0 -5) it would follow that when back-calculating from an acceptable site risk value (1x10 -6) to a specific soil cleanup value, the resulting concentrations should also reflect the UCL.

10 The UCL, which followed the identical approach used in the Human Health Baseline Risk Assessment, defined the soil exposure point concentrations as the upper limit of the 95 percent confidence interval of the arithmetic mean.

PRGs were initially developed for carcinogenic PAHs, arsenic and beryllium. Ultimately beryllium was removed from further consideration. This decision was based on the consideration that only two of the 43 subsurface soil samples exceeded the PRG calculated for beryllium.

When evaluating the potential risk associated with exposure to carcinogenic PAHs, the toxicity associated with benzo(a)pyrene is used as a point of reference. The concentration of cPAHs can be evaluated by relating the toxicity of each cPAH to benzo(a)pyrene. For example, benzo(a)anthracene has a relative potency factor of 0.1. If the benzo(a)anthracene concentration is 5 mg/kg, it is toxicologically equivalent to a BaP concentration of 0.5 mg/kg. These concentrations are referenced throughout the remainder of this ROD as Benzo(a)Pyrene toxicity equivalents, or B(a)Peq. The selected PRG for B(a)Peq is 1.7 ppm and the PRG for arsenic is 7.6 ppm.

Based or Summers model results as presented in Section 8.2 of the RI report, a cPAH soil remedial goal protective of groundwater was not necessary since such a goal would be several orders of magnitude greater than soil remediation levels associated with direct or indirect exposures.

7.1.2 Groundwater/NAPL

A source area of subsurface NAPL in addition to an impacted area of groundwater have been identified at the site. The presence of NAPL as reported in the RI can be grouped around the MGP; more specifically the former gas holder, the former rail spur, and the former oil tanks. The NAPL source areas that will be addressed are illustrated on Figure 7-1. The general locations for the placement of recovery wells addressing the dissolved phase plume are also shown in Figure 7-1. This figure represents general locations for both NAPL recovery wells and groundwater recovery wells. The exact locations and number of wells may be modified or expanded based on remedial design considerations.

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EPA has adopted the long-term remediation objectives for sites where NAPL is encountered in groundwater as presented in the EPA OSWER Directive 9234.2-25, "Guidance for Evaluating the Technical Impracticability of Groundwater Restoration (EPA 1993)". In general EPA's groundwater/NAPL remediation objectives are:

- Removal or treatment of NAPL to the maximum extent practicable;
- Containment of potentially non-restorable source areas; and
- Restoration of aqueous contaminant plumes.

A phased approach for groundwater remediation will be used to achieve these objectives at this Site. The initial effort will concentrate on removal or treatment of NAPLs previously identified atthe former gas holder, the former rail spur, and the former oil tanks. This would typically consist of free-phase NAPL removal aided by pump-and-treat. Removal of NAPLs is anticipated to have the effect of mitigating the primary contaminant source responsible for groundwater contamination at this Site. Concurrent with the NAPL removal, additional actions will be undertaken to restore the aqueous contaminant plumes to meet MCLs.

The NAPLs removal will be monitored to evaluate the practicability of such actions. Should complete source removal or treatment prove impracticable, the use of migration controls or containment measures will be taken for the non-restorable source areas, The determination of technical impracticability will be made by EPA, in consultation with SC DHEC, based on site-specific characterization data and remedy performance data. Such data would include, but not necessarily be limited to:

- A demonstration that contaminant sources have been removed and contained to the maximum extent practicable;
- An analysis of the performance of any ongoing or completed remedial actions;
- Predictive analysis of the time frames to attain required cleanup levels using available technologies; and
- A demonstration that no other remedial technologies could attain the cleanup levels within a reasonable time frame.

Should EPA ultimately make a determination of technical impracticability based on an evaluation of the supporting data, the remedy would be re-evaluated and documented by a ROD amendment. The groundwater/NAPL alternatives developed in the FS Report and summarized in this ROD will focus on a phased approach to achieving the three groundwater/NAPL remediation objectives listed above. Ultimately it is it is expected that the MCLs listed below will apply to this Site. Carbazole is the one exception where the value listed is based on risk-based calculation rather than an MCL.

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GROUNDWATER CONTAMINANTS (PPM)

Contaminant	Maximum Detected	Cleanup Goal
Arsenic	0.088	0.05
Cyanide	4.5	0.2
Benzene	5.2	0.005
2,4-Dimethylphenol	0.89	0.7
Benzo(a)pyrene	0.038	0.0002*
Ethyibenzene	1.2	0.7
Beryllium	0.013	0.004
Lead	1.9	0.015
Carbazole	0.15	0.005**
Mercury	0.015	0.002
Chrysene	0.16	0.020
Naphthalene	5.5	1.5
Chromium	0.13	0.1
Nickel	0.30	0.1
Copper	5.1	1.3
Toluene	1.8	1.0

*Represents PAHs as a group.
**Based on actual risk calculation rather than MCL

7.2 Soil Alternatives

The following information presents the different cleanup alternatives which were initially considered for remediating the contaminated soils at the Site.

7.2.1 Alternative 1: No Action

The No Action Alternative entails performing no remedial activities and is included in accordance with the NCP.

7.2.2 Alternative 2: Natural Attenuation

This alternative would involve the processes of natural attenuation to degrade soil contamination over time. Natural Attenuation is dependent upon demonstrating that contaminant levels are decreasing due to natural processes. The use of Natural Attenuation is dependent upon several factors including the monitoring of contaminant levels in soils, existing microbial populations, nutrient levels, and electron acceptor conditions. This alternative will be eliminated from further consideration due to implementability constraints associated with the planned development for the Site, specifically buildings and urban cover.

7.2.3 Alternative 3: Surface Cover/Capping

This alternative consists of utilizing a low permeability surface cover to isolate the contaminated soil from direct human contact and reduce infiltration of surface waters through these same area. The surface cover would be constructed of low permeability soils or other man made materials. This alternative will be retained for further evaluation.

7.2.4 Alternative 4: In Situ Bioremediation

This alternative involves the application of an electron acceptor and nutrients to enhance any naturally occurring biodegradation which may be occurring at the Site. Potential electron acceptors and nutrients could include oxygen, hydrogen peroxide, or nitrate which would be introduced. into the contaminated soil. Due to implementability constraints associated with buildings, an expected lengthy treatment duration, and lack of fit with the planned site use, this alternative will be eliminated from further consideration.

7.2.5 Alternative 5: Excavation, Chemical/Biological Treatment, & Replacement

This alternative would initially involve the excavation of contaminated soil. Debris would be steam cleaned and disposed of in a landfill. The soils would be added to a slurry reactor along with a chemical oxidant. This slurry would then be dewatered followed by the addition of nutrients and air into the reactors. Following this treatment the soil would be dewatered and backfilled into the excavation. Due to implementability constraints including limited available on-site space, this alternative will be eliminated from further consideration.

7.2.6 Alternative 6: Excavation, Thermal Desorption, & Replacement

This alternative would consist of excavating the contaminated soil and treating the soil in an on-site low temperature thermal desorption unit. This process requires heating the soil to elevate the vapor pressure of the contaminants which would enable diffusion through, and volatilization from, the soil. The treated soil would then be used to backfill the excavation areas.

Thermal desorption is affected by several factors including the type of contaminants present, their concentrations in the soil, their desorption temperature, and the duration of treatment, Due to space limitations, possible recalcitrant contaminants, and public relation concerns within this highly populated area, this alternative will be eliminated from further consideration.

7.2.7 Alternative 7: Excavation & Off-Site Incineration

This alternative would involve excavating the contaminated soil and transporting them to an off-site facility for incineration. The excavated areas would then be backfilled with clean fill material. This alternative is generally effective for treating similar sites and will be retained for additional evaluation.

7.2.8 Alternative 8: Excavation & Off-Site Landfill

This alternative involves excavating the soils followed by transportation to an off-site landfill. Following excavation, the area will be backfilled with clean fill. Presently the waste associated with MGPs are not subject to the Land Disposal Restriction but are regulated as hazardous because they typically exhibit a toxicity characteristic of hazardous waste, most often due to the concentration of benzene. Overall this still remains a viable alternative and will be retained for evaluation.

7.3 Shallow Groundwater

The following sections address the remedial alternatives for shallow groundwater. In the context of the site wide groundwater objectives this requires addressing both the dissolved phase portion of the plume in addition to the removal or treatment of NAPLs. The removal or treatment of NAPLs is referenced to as source removal in these following sections.

7.3.1 Alternative 1: No Action

The No Action Alternative would leave the Site groundwater untreated. Long term monitoring of the groundwater would be included to monitor site specific contaminants of concern. The No Action alternative is retained throughout the FS in accordance with the NCP.

7.3.2 Alternative 2: Institutional Controls

Under this alternative no remediation would be performed and site groundwater would remain untreated. This alternative would involve imposing restrictions on the future uses of groundwater at the Site. These institutional controls would consist of deed restrictions and access restrictions. This alternative will not be retained for further evaluation as it is not capable of meeting the three groundwater objectives stated in section 7.1 Development of Cleanup Levels. While this alternative will be eliminated as a stand-alone alternative, it will be combined with other alternatives to address contaminated shallow groundwater.

7.3.3 Alternative 3: Institutional Controls, Source Removal, Phytoremediation, and Natural Attenuation

This alternative utilizes institutional controls as mentioned in the preceding alternative in combination with several other processes including source removal (NAPLs), phytoremediation and natural attenuation. Source removal would consist of extracting NAPL from known NAPLs locations via recovery wells followed by either reuse, energy recovery, or destruction of recovered material. The phytoremediation would involve the planting of specifically selected tree species which are theoretically capable of breaking down the contaminants present in the groundwater. The natural attenuation approach would assess electron acceptors and nutrients in addition to evaluating the microbiological populations and conditions. While there is no evidence that this particular combination of processes would be effective for the site specific contaminants and conditions, it has the potential to work under limited conditions. As such it will be retained for further evaluation.

7.3.4 Alternative 4: Institutional Controls, Source Removal, Phytoremediation, and In Situ Bioremediation

This alternative would utilize those technologies/processes described in alternative 3 but replace natural attenuation with in situ bioremediation. This would require the application of an electron acceptor and nutrients to the shallow groundwater in order to stimulate biological degradation of the contaminants. While this alternative is considered to be marginally implementable due to constraints of placement and access to injection points, it will be retained for further consideration.

7.3.5 Alternative 5: Institutional Controls, Source Removal, Phytoremediation, Grout Curtain, Vertical Wells, Separation, Filtration, GAC, and POTW Discharge

This alternative would utilize a portion of the technologies/processes described in alternative 4 (institutional Controls, Source Removal, Phytoremediation) in combination with a downgradient grout curtain to contain groundwater. Additionally this alternative also includes the extraction of the dissolved phase groundwater plume. This extracted groundwater would then undergo separation, filtration, and granular activated carbon treatment before discharging to a sanitary sewer system (POTW). Although site specific conditions would result in implementation constraints for this alternative (existing electrical substation and underground utilities), this alternative will be retained for further evaluation.

7.3.6 Alternative 6: Institutional Controls, Source Removal, Phytoremediation, Sheet Piling, Vertical Wells, Separation, Filtration, GAC, and POTW Discharge

This alternative would utilize the technologies/processes described in alternative 5 but would substitute sheet piling for the grout curtain. The sheet piling would essentially act to retain the groundwater in a manner similar to the grout curtain. This alternative has been eliminated from further consideration due to the implementation difficulties, especially those associated with installing sheet piling in areas having underground utilities.

7.3.7 Alternative 7: Institutional Controls, Source Removal, Phytoremediation, Interceptor Trenches, Separation, Filtration, GAC, and POTW Discharge

This alternative is a variation of alternative 6 and uses interceptor trenches instead of sheet piling. The interceptor trench or trenches would act as a barrier to the migration of shallow groundwater. Due to implementation difficulties associated with the presence of underground utilities, this alternative was eliminated from further consideration.

7.3.8 Alternative 8: Institutional Controls, Source Removal, Phytoremediation, Vertical Wells, Separation, Filtration, GAC, and POTW Discharge

This alternative is similar to alternative 5 with the exception of omitting the grout curtain and in turn depending entirely upon the use of vertical wells to attain hydraulic control. Because this alternative would potentially address the groundwater objectives for this site, it will be retained for further evaluation.

7.4 Intermediate Groundwater

This section presents alternatives developed to address contaminated groundwater in the intermediate aquifer.

7.4.1 Alternative 1: No Action

The No Action alternative would leave the intermediate groundwater untreated. Long term, monitoring of the intermediate groundwater would be included to determine groundwater conditions over time. This alternative is retained throughout the FS in accordance with the NCP.

7.4.2 Alternative 2: Institutional Controls

Under this alternative no remediation would be performed and site groundwater would remain untreated. This alternative would involve imposing restrictions on the future uses of groundwater at the Site. These institutional controls would consist of deed restrictions and access restrictions. This alternative will not be retained for further evaluation as it is not capable of meeting the three groundwater objectives stated in section 7.1 Development of Cleanup Levels. While this alternative will be eliminated as a stand-alone alternative, it will be combined with other alternatives to address contaminated shallow groundwater.

7.4.3 Alternative 3: Institutional Controls and Natural Attenuation

This alternative utilizes institutional controls as mentioned in the preceding alternative in combination with natural attenuation. The natural attenuation approach would assess electron acceptors and nutrients in addition to evaluating the microbial populations and conditions. While there is no evidence that this particular combination of processes would be effective for the site specific contaminants and conditions, it has the potential to work under limited conditions. As such it will be retained for further evaluation.

7.4.4 Alternative 4: Institutional Controls and In Situ Bioremediation

This alternative would utilize the institutional controls described above in conjunction with in situ bioremediation. Bioremediation would be approached through the application of an electron acceptor and nutrients to the groundwater to stimulate biological degredation of the contaminants. While this alternative is considered to be marginally implementable due to constraints of placement and access to injection points, it will be retained for further consideration.

7.4.5 Alternative 5: Institutional Controls, Vertical Wells, Separation, Filtration, GAC, and POTW Discharge

In addition to the institutional controls this alternative would include the installation of vertical wells to remove intermediate groundwater for treatment and hydraulic control. Additionally this alternative also includes the extraction of the dissolved phase groundwater plume. This extracted groundwater would then undergo separation, filtration, and granular activated carbon treatment before discharging to a sanitary sewer system (POTW). This alternative will be retained for further evaluation.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The objective of this section of the ROD is to evaluate the relative performance of the alternatives with respect to the nine evaluation criteria, so that the advantages and disadvantages of each are clearly understood. The Threshold Criteria must be met for an alternative to be selected. These criteria are presented in Sections 8.1 and 8.2, followed by a discussion presented in the following media-specific subsections: 1) soils; 2) shallow groundwater; and 3) intermediate groundwater. Sections 8.3 through 8.7 present the Balancing Criteria, which are used to weigh the major advantages and disadvantages of each remedial alternative. The discussion in these Sections is organized using the same media-specific subdivisions. Sections 8.8 and 8.9 discuss State Acceptance and Community Acceptance, respectively.

8.1 Overall Protection of Human Health & the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls

8.1.1 Soil

Four remedial action alternatives for soil were retained for detailed evaluation. These include:

- Alternative 1: No Action;
- Alternative 3: Surface Cover/Capping;
- Alternative 7: Excavation & Off-Site Incineration; and
- Alternative 8: Excavation & Off-Site Disposal

In the following analysis these alternatives are compared to one another against the nine criteria. The relative advantages and disadvantages of each alternative are also summarized in the following table.

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Overall Protection of Human Health and the Environment

Alternative 7, Excavation & Off-Site Incineration, and Alternative 8, Excavation & Off-Site Land filling, both provide the most protection to human health and the environment through the removal of impacted soil thereby preventing potential future exposure. Both of these alternatives are considered the most effective alternatives in meeting this criteria.

Alternative 3, Surface Cover/Capping, would provide limited protection for some exposure pathways but not to the future on-site construction workers. It also does not address the soil to groundwater pathway for migration of contaminants. The No-Action alternative would not provide adequate protection of human health and the environment and is not considered effective in meeting this criteria.

Compliance with Applicable or Relevant and Appropriate Requirements

Alternatives 7, and 8 could be designed appropriately to be in compliance with all federal and state applicable or relevant and appropriate requirements (ARARs) and are all considered effective in meeting this criteria. Alternative 3, Cover/Capping may meet action specific and location-specific ARARs but may not meet chemical-specific ARARs. The No Action alternative does not meet the ARARs for protecting human health and the environment and is considered ineffective in meeting this criteria.

Short-Term Effectiveness

While alternatives 3, 7, and 8, are capable of meeting this criteria to varying degrees, Alternative 3, Surface Cover/Capping, would be the most effective in meeting this criteria. Alternatives 7 and 8 are least effective in meeting this criteria due to short term risk associated with worker exposure during excavation and transportation activities. Alternative 1, No Action, would have no short term effectiveness.

Long-Term Effectiveness

Alternatives 7 and 8 would both provide the greatest long-term effectiveness due to removal of the impacted soil. Because Alternative 7 includes destruction of impacted soil via incineration, it would be the best choice in meeting the long-term effectiveness criteria. Alternative 3, Surface Cover/Capping, would be somewhat less effective over the long term since it would rely on periodic maintenance of the cover/cap to maintain its integrity. The No Action alternative would not provide any long term effectiveness.

Reduction of Toxicity, Mobility, or Volume

Alternative 7, Excavation and Off-Site Incineration, would reduce the toxicity, mobility, and volume of impacted soil and is considered to be the most effective alternative in meeting this criteria. Alternative 8, Excavation & Off-Site Landfilling, provides a reduction in toxicity and mobility but does not reduce the volume and is therefore slightly less effective in meeting this criteria. Alternative 3, Cover/Capping, would also reduce mobility and toxicity. The No Action alternative would not effectively meet this criteria.

Implementability

The No Action alternative meets this criteria and would also be the easiest alternative to implement. Alternative 3, Cover/Capping, is also readily implementable for this site.

Alternative 7, Excavation & Off-Site Incineration, and Alternative 8, Excavation & Off-Site Incineration, would be implementable but are also the most difficult of the alternatives to implement.

Present Worth Costs

Since there would be no costs associated with the No Action alternative, it is inherently the most desirable in meeting this criteria. Alternative 3, Cover/Capping ($458,000) is more expensive than the No Action alternative but considerably less costly than alternatives 7 ($7,570,000) and 8 ($2,280,000). Alternative 7, Excavation & Off-Site Incineration, and Alternative 8, Excavation & Off-Site Incineration, would be considered the most expensive to implement and are the least desirable from a cost alone consideration.

8.1.2 Shallow Groundwater/NAPL

As discussed previously, in Section 7.1.2 the remedial action objectives for sites where NAPL is encountered in groundwater consists of the following:

Removal or treatment of NAPL to the maximum extent practicable; Containment of potentially non-restorable source areas; and Restoration of aqueous contaminant plumes.

Five alternatives were retained for comparative evaluation of the shallow groundwater. These alternatives consist of the following:

- Alternative 1: No Action;
- Alternative 3: Institutional Controls, Source Removal, Phytoremediation, and Natural Attenuation;
- Alternative 4: Institutional Controls, Source Removal, Phytoremediation, and In Situ Bioremediation;
- Alternative 5: Institutional Controls, Source Removal, Phytoremediation, Grout Curtain, Vertical Wells, Separation, Filtration, GAC, & POTW Discharge; and
- Alternative 8: Institutional Controls, Source Removal, Phytoremediation Vertical Wells, Separation, Filtration, GAC, & POTW Discharge.

With the exception of Alternative 1, the No Action alternative, all remaining alternatives include source removal in accordance with the first remedial action objective. The remaining alternatives differ in their approach to addressing the remaining two objectives, specifically that of containing potentially non-restorable source areas and restoration of

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Overall Protection of Human Health and the Environment

The primary component of this evaluation criterion is the ability of a remedial alternative to achieve the remedial action objectives established for groundwater. This would consist of the removal, treatment and containment of NAPL and the containment and restoration of aqueous contaminant plumes. Alternatives 5 and 8 would meet these objectives and is therefore considered to be two alternatives most protective of human health and the environment, These technologies have been well established at other sites.

Alternatives 3 and 4 may be capable of meeting this criteria under controlled conditions, however, such site specific conditions were not effectively established as of the writing of this ROD. It would follow that there is some uncertainty as to their effectiveness in meeting the criteria of overall protection of human health and the environment. Limitations on locations for tree planting is limited and irregularly spaced which could impact the effectiveness of phytoremediation.

Since the no-action alternative does not include active measures to address groundwater/NAPL except for what is planned under the Interim Remedial Action, this alternative is not protective.

Compliance with ARARs

Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address hazardous substances, the remedial action to be implemented at the site, the location of the site, or other circumstances present at the site. Relevant and appropriate requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law which, while not applicable to hazardous materials found at the site, the remedial action itself, the site location or other circumstances at the site, nevertheless address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the site. Compliance with ARARs addresses whether a remedy will meet all of the ARARs of other federal and state environmental statutes or provides a basis for invoking a waiver.

Alternatives 3, 4, 5, and 8 were evaluated with respectto action-specific, chemical-specific, and location-specific ARARs. Alternatives 3, 4, 5, and 8 all incorporate technologies to contain and/or potentially recover NAPL and impacted groundwater from the source areas on-site. While achievement of MCL-based cleanup levels may be technically impracticable at sites with NAPL contamination, Alternatives 5 and 8 incorporate a series of extraction wells that are expected to have a beneficial impact on the restoration of dissolved-phase aqueous plumes downstream of the source area in the former Treatment Area. Therefore, Alternatives 5 and 8 provide the highest degree of compliance with ARARs.

Alternative 3 relies solely on phytoremediation and natural attenuation for groundwater containment and restoration and therefore receives a lower rating for this criterion. While research does indicate that phytoremediation via trees can successfully treat groundwater contaminated with BTEX and some inorganic compounds under controlled conditions, there is no research indicating their effectiveness on PAH contaminated groundwater. Other phytoremediation studies, using grasses to remediate PAHs, have shown some effectiveness on soils but not groundwater. Additionally these studies were limited to anthracene and pyrene in soils and not groundwater. In a similar manner Alternative 4 relies entirely upon phytoremediation and in situ bioremediation for containment and restoration and therefore receives a lower rating than alternatives 5 and 8.

Short-Term Effectiveness

Short-term effectiveness refers to the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during construction and implementation of the remedy until Performance Standards are achieved. The primary factors influencing ratings for short-term effectiveness are potential adverse impacts to the community and/or remediation workers during site construction activities, potential environmental impacts and duration of remedy implementation activities.

None of the alternatives were significantly better than the others with regards to short-term effectiveness. Alternatives 3 and 4 can be implemented quickly with minimal disruption yet the growth period required for phytoremediation would require several growing seasons to reach its maximum effectiveness. Alternatives 5 and 8 could be effective within a relatively short time frame but would have potential short-term risk associated with worker exposure to contaminated groundwater recovered during the initial installation. For these reasons alternatives 3 and 4 received a slightly higher rating for short-term effectiveness than alternatives 5 and 8. The No Action alternative would not be considered to have any short-term effectiveness.

Long-Term Effectiveness

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once Performance Standards have been met. This criterion includes the consideration or residual risk and the adequacy and reliability of controls.

While alternatives 3, 4, 5, and 8 may all effectively meet this criteria, the long-term effectiveness for alternatives 5 and 8 have been better documented than for alternatives 3 and 4. Once again it should be noted that the technologies associated with alternatives 3 and 4 may be capable of meeting this criteria under controlled conditions, however, such site specific conditions have not been effectively established for this site to date. Due to the uncertainty associated with alternatives 3 and 4, alternatives 5 and 8 received the higher ratings for long-term effectiveness. The No Action alternative is considered ineffective in regards to long-term effectiveness.

Reduction of Toxicity, Mobility or Volume

This criterion evaluates the reduction in toxicity, mobility or volume through the treatment technology components of the remedial alternatives.

Alternatives 5, and 8 will reduce the TMV of the contaminants of concern in, shallow groundwater and as such received the highest ratings among the alternatives when evaluated against this criteria. Alternatives 3 and 4 will likely reduce the mobility, volume, and to a lessor extent some of the toxicity associated with groundwater contamination via phytoremediation. While phytoremediation may act to contain the groundwater it is not expected to effectively degrade all the contaminants of concern. The No Action alternative would not effectively reduce the TMV.

Implementability

This criterion addresses the relative ease of remedy implementation and the availability of treatment technologies necessary to meet Performance Standards.

The No Action alternative is considered the most effective in meeting this criteria. All the remaining alternatives are implementable yet require varying degrees of effort for their implementation. Alternative 3 would require the least amount of effort among the remaining alternatives. Alternative 5 would be the least implementable due to the major construction associated with the grout curtain.

Present Worth Costs

This criterion evaluates the present worth costs of the developed remedial alternatives. Since there would be no cost associated with the No Action alternative other than groundwater monitoring, it receives the highest rating among the alternatives for this criteria at $307,000, Alternative 3 is the second least costly alternative ($1,426,000) followed closely by alternative 4 ($1,931,000). The remaining alternatives (5 and 8) represent a substantial increase cost over the other alternatives at $4,961,000 and $5,463,000.

8.1.3 Intermediate Groundwater

The groundwater remedial action objectives for the intermediate groundwater are similar to those applied to the shallow groundwater in section 8.1.2. The remedial action objectives for sites where NAPL is encountered in groundwater consists of the following:

- Removal or treatment of NAPL to the maximum extent practicable;
- Containment of potentially non-restorable source areas; and
- Restoration of aqueous contaminant plumes.

The RI revealed the presence of both NAPL and a dissolved phase contaminant plume within the intermediate aquifer. While NAPL appears to be isolated within the area of the gas holder, the extentof the dissolved phase contaminant plume was not well defined during the RI. Because the extent of the dissolved groundwater contaminant plume within the intermediate aquifer was not well defined during the Remedial Investigation, additional investigation will be performed to characterize the extent of this contamination and presented as operable unit two under a separate ROD. This ROD will address the issue of source removal (and disposition of this source) for the intermediate aquifer within the Selected Remedy section of this ROD.

8.8 STATE ACCEPTANCE

SC DHEC does concur with EPA's selected remedy described in Section 9.0. The SC DHEC concurrence letter is attached to this ROD as Appendix A. SC DHEC believes that EPA's selected remedy will be of benefit in the reduction of risk at the site achieving long term protection of human health and the environment.

8.9 COMMUNITY ACCEPTANCE

A public meeting was held on March 1998 to discuss the remedial alternatives under consideration and EPA's Proposed Plan for cleanup of the Calhoun Park Superfund Site. A 60-day public comment period on EPA's Proposed Plan was held from March 16, 1998 to May 15, 1998. A copy of all comments received, EPA's response to these comments, and a verbatim transcript of the March 1998 meeting are attached to this ROD as Appendix B, The Responsiveness Summary. In general the community expressed acceptance with EPA's Proposed Plan as presented during the public meetings.

9.0 THE SELECTED REMEDY

This section of the document provides a description of the components of EPA's selected remedy on Operable. Unit One for the Calhoun Park Superfund Site in Charleston, South Carolina. The Performance Standards and other ARARs of EPA's selected remedy are delineated in the sections that follow. The remedy described has been selected under the authority granted in CERCLA and is consistent with the requirements of the NCP. EPA's selected remedy is based upon a full consideration of remedial alternatives and all comments received during the 60-day comment period on the Proposed Plan. Cost details of EPA's selected remedy are delineated in Section 9.4.

9.1 Soil - Excavation and Off-Site Disposal

The overall objective of the soil component of EPA's selected remedy is to provide for adequate protection of the construction worker under a future industrial land-use exposure scenario. As discussed in Section 6.0 of this document, EPA's Human Health Baseline Risk Assessment utilized conservative exposure pathways and assumptions to estimate the potential risks posed to the future on-site worker. Under the future industrial exposure scenario, unacceptable carcinogenic and non-carcinogenic risks were calculated for the future on-site worker exposed to subsurface soils (six inches to water table). Exposure pathways quantified were incidental ingestion of and dermal contact with soils.

EPA's Human Health Baseline Risk Assessment developed cleanup levels for surface and subsurface soils within EPA's protective risk range of 1×10^{-4} to 1×10^{-6} . The soil remedy consists of the excavation of an estimated 6,080 tons of impacted soil with subsequent off site disposal in an approved landfill. EPA's selected soil remedy will eliminate exposure to unacceptable concentrations of constituents in soil and permit beneficial future use of the property.

All excavation activities shall be conducted in a manner which provides adequate short-term protection of on-site workers, and minimizes disruptions to local businesses and adjacent neighborhoods. Air monitoring during active excavation shall be implemented for the protection of on-site workers and to assess potential off-site impacts. As warranted, dust and odor control measures shall be instituted to mitigate adverse impacts in the active excavation areas, haul roads and adjacent off-site areas. On-site excavations shall be backfilled and restored to a condition consistent with the intended future use of the property.

All excavated soil shall be transported off-site for disposal in an approved hazardous waste landfill. All transportation and off-site disposal activities shall be conducted in full accordance with all ARARs, including but not limited to, RCRA and DOT regulations.

9.2 Groundwater/NAPL

EPA's groundwater/NAPL remediation strategy presented in this section applies to the shallow aquifer described in Section 5.2. NAPL source removal, followed by either reuse, energy recovery, or destruction of recovered material, will also be required for the intermediate aquifer. Additional performance standards may be required for this intermediate aquifer pending characterization of the dissolved phase contaminant plume.

Implementation of the groundwater/NAPL remedy at this site shall be consistent with OSWER Directive 9234.2-25, Guidance for Evaluating the Technical Impracticability of Groundwater Restoration (EPA 1993). This guidance promotes an iterative, phased approach which includes early actions to remove contaminant sources, control plume migration, and mitigate risks posed by impacted groundwater.

9.2.1 NAPL/Groundwater

The source areas of subsurface NAPL have been defined on-site, as presented in Sections 5.2. These areas are referred to as the former gas holder, the former rail spur, and the former oil tanks. The goal of EPA's groundwater/NAPL remedy is the restoration of impacted groundwater at these source areas to the ARAR-based cleanup levels, Maximum Contaminant Levels specified by the Safe Drinking Water Act. However, EPA recognizes that restoration to these levels may be technically impracticable given the characteristics of NAPL, limitations in remediation technology and/or complex hydrogeology. Therefore, the groundwater/NAPL remedy in the three NAPL source areas shall, at a minimum, achieve the following Performance Standards:

1) Removal or treatment of NAPL to the maximum extent practicable;

2) Containment of potentially non-restorable source areas; and

3) Containment and restoration of aqueous contaminant plumes.

The above Performance Standards shall be achieved by the recovery of NAPL and impacted groundwater by extraction wells installed in the shallow aquifer underlying the three source areas. An additional extraction well or wells will be installed in the intermediate aquiferin the area of the former gas holder. Figure 7-1 provides an illustration of the source areas and general locations of extractions wells. Disposal options for the recovered NAPLs material may include reuse, energy recovery, or destruction.

All groundwater recovered via this remedy component shall be treated to meet the ARARs of the selected discharge option. It is envisioned that all recovered groundwater will be conveyed to an on-site water treatment system. The water treatment system shall be properly operated and maintained to meet the discharge requirements imposed by the Charleston POTW.

The full-scale groundwater/NAPL remedy shall be monitored, modified and/or enhanced where appropriate to demonstrate that best professional efforts have been made to achieve ARAR-based cleanup levels and the applicable Performance Standards of this remedy component. A comprehensive monitoring network will be established to delineate the NAPL zone and aqueous contaminant plume. The data generated by this monitoring program will be utilized to track the effectiveness of the remedy in achieving the established objectives. The conceptual remedy described herein may be modified and enhanced as warranted based on review and analysis of monitoring data generated.

Recovery and treatment enhancements may include the installation of additional extraction wells. EPA considers the full-scale groundwater/NAPL remedy to be an iterative process which must be conducted for a sufficient period of time before its ability to meet applicable cleanup levels and long-term Performance Standards can be fully evaluated. All decisions regarding the technical impracticability of achieving ARAR-based cleanup levels and the long-term Performance Standards at the three NAPL source areas shall be made by EPA, with consultation by SC DHEC.

Phytoremediation will also be used as a supplemental technology to the extraction wells/separation/filtration system in the shallow aquifer. While the existing research does not prove that trees would be effective upon all site-specific contaminants, this technology would be effective on some of the contaminants thereby reducing the overall contaminant mass and doing so in a low cost approach.

Because phytoremediation is a relatively new technology, its performance upon the contaminants of concern under these site-specific conditions is untested. For this reason this technology will be implemented on a limited basis, concurrent with an extraction well recovery/treatment system, to evaluate its effectiveness on the dissolved phase portion of the plume. Should phytoremediation prove effective in meeting the performance standards, this technology could eventually be used to replace portions of the extraction well/separation/filtration system.

9.3 Cost Summary

This section of the document provides a cost summary for the key elements of EPA's selected remedy at the Calhoun Park Superfund Site. The estimated capital costs for each major remedy component, estimated operation and maintenance (O&M) costs, and total net present worth over a 30-year period are provided below. All cost estimates are expressed in 1997 dollars and are based upon conceptual engineering, design and construction. The reader is referred to the Final FS Report for a more detailed breakout of the cost information summarized below.

Soil and Drainage Ditch Sediments
Excavation of 6,080 tons.....................................$152,000
Transportation and off-site disposal of 6,080 tons..........$1,800,000
Backfill..$121,600

Sub-Total Soil Component...............$2,280,000

Groundwater/NAPL

Source removal, recovery system and phytoremediation..........$997,000
Total Annual Operation & Maintenance.........................$290,000

Present Worth Cost (Interest rate 5% over 30 yrs)...........$5,463,000

Total Estimated Cost of EPA's Selected Remedy..............$7,743,,000

10.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element. The following sections discuss how the selected remedy meets these statutory requirements.

10.1 Protection of Human Health and the Environment

EPA's selected remedy protects human health and the environment through media-specific components designed to eliminate or mitigate potential risks posed by the site. EPA's remedy consists of: excavation and off-site disposal of 6,080 tons of impacted soil; containment and recovery of NAPL and groundwater.

Excavation of 6,080 tons of the impacted soil will eliminate potential risks posed to the future construction worker by exposure to surface/subsurface soils. All excavated soil will be disposed off-site in a controlled and permitted landfill. The excavation and off-site disposal of impacted soils provides a residual risk (post-remediation risk) of $1x10^{-6}$ which is at the more protective end of EPA's acceptable risk range.

The Performance Standards developed for groundwater and NAPL at the source areas will remove and treat NAPL to the maximum extent possible, contain potentially non-restorable source areas, and contain/restore aqueous contaminant plumes. All recovered groundwater will be treated to protective levels prior to discharge. Groundwater in the shallow aquifer is not currently used for residential or industrial purposes, however, EPA's selected remedy will eliminate risks posed by off-site transport to surface water bodies and drainage ditches.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

EPA's selected response action will meet all ARARs discussed in Section 9.0 of this document. These include, but are not limited to:

- RCRA Requirements for Identification, Management and Transportation of Hazardous Waste (40 CFR 261, 262 and 263)
- RCRA Land Disposal Restrictions (40 CFR 268)
- DOT Hazardous Materials Regulations (49 CFR 107 and 171-179)
- Safe Drinking Water Act (40 CFR 141)
- Clean Water Act (40 CFR 403 and 404)
- Coastal Zone Management Act (15 CFR 930)
- OSHA Health and Safety Requirements (29 CFR 1910 and 1926)

10.3 Cost Effectiveness

EPA's selected response action will provide adequate protection of human health and the environment at an estimated cost of $7,743,000. The soil component of EPA's selected remedy involves the excavation and off-site disposal of 6,080 tons of impacted soil. EPA's selected soil remedy provides an estimated residual risk, or post-remediation risk of 1×10^{-6} at an estimated cost of $2,280,000.

The groundwater/NAPL component addresses source removal (NAPLs) for both the shallow and intermediate groundwater units and dissolved phase plume in the shallow groundwater unit at an estimated present worth cost of $5,463,000. The decision to incorporate phytoremediation as part of the groundwater treatment technology may provide a substantial reduction in this estimated costs, should this technology prove effective, and thereby enhance cost effectiveness.

Based upon the above discussion, EPA has determined that the selected remedy provides protectiveness that is proportionate to its costs and represents a reasonable value for the money that will be spent.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner for the response action at the Calhoun Park Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that this selected remedy provides the best balance in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and considering state/community acceptance. The implementation of this remedy is also expected to result in positive economical and environmental benefits to the local community.

The groundwater/NAPL remedy component involves technologies that recover NAPL to the maximum extent practicable at the three source areas on-site. All recovered groundwater will be treated to permanently reduce contaminant concentrations to appropriate standards. This component also selects innovative phytoremediation technology as a supplemental remedy for restoration and hydraulic control of the dissolved-phase aqueous contaminant plumes downgradient of NAPL source areas.

10.5 Preference for Treatment as a Principal Element

EPA's selected remedy will fulfill the preference for treatment as a principal element through the recovery and treatment of impacted groundwater and NAPL. Furthermore, this response action incorporates phytoremediation as an innovative groundwater treatment in conjunction with an extraction well/recovery system.

APPENDIX A

STATE CONCURRENCE LETTER

<IMG SRC 98104M>

September 30, 1998

2600 Bull Street
Columbia, SC 29201-1708

COMMISSIONER:
Douglas E. Bryant

John H. Hankinson, Jr.
Regional Administrator
U.S. EPA, Region IV
61 Forsyth St., SW
Atlanta, GA 30303

RE: Calhoun Park Superfund Site - Record of Decision

Dear Mr. Hankinson:

The Department has reviewed and concurs with all pans of the revised Record of Decision (ROD) dated September 23, 1998 for the Calhoun Park located in Charleston, S.C. In concurring with this ROD, the South Carolina Department of Health and Environment Control (SCDHEC) does not waive any right or authority it may have under federal or state law. SCDHEC reserves any right or authotity it may have to require corrective action in accordance with the South Carolina Pollution Control Act. These rights include, but are not limited to, the right to insure that all necessary permits are obtained, all clean-up goals and criteria are met, and to take separate action in the event clean-up goals and criteria are not met. Noting in the concurrence shall preclude SCDHEC from exercising any administrative, legal and equitable remedies available to require additional response actions in the event that: (l)(a) previously unknown or undetect conditions arise at the site, or (b) SCDHEC receives additional information not previously available concerning the premises upon which SCDHEC relied in concurring with the selected alternative; and (2) the implementation of the remedial alternative selected in the ROD is no longer protective of public health and the environment.

SCDEC concurs with the selected alternative for contaminated soils consisting of excavation and disposal in a permitted landfill followed by the backfilling of the excavated areas with clean fill. SCDHEC concurs with the selected groundwater alternative consisting of source removal of NAPLs from both the shallow and intermediate aquifer and treatment of the groundwater plume through a combination of recovery wells/filtration system and Phytoremediation.

<IMG SRC 98104N>

cc: Hartsill Tuesdale
Keith Lindler
Wayne Fanning, Trident EQC
Gary Stewart

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

APPENDIX B
RESPONSIVENESS SUMMARY

CALHOUN PARK SUPERFUND SITE
CHARLESTON, SOUTH CAROLINA

1. Comment: Correspondence from the South Carolina Department of Health & Environmental Controls Office of Ocean and Coastal Resource Management (OCRM) group dated March 26, 1998, requests that EPA comply with the Federal Consistency provisions of the Coastal Zone Management Act, 15 CFR 930.

Response: All activities will be performed to meet the substantive requirements for State of South Carolina's OOCRM for activities occurring in coastal zone. Such activities would include, but not necessarily be limited to, the management of surface water run-off during remedial actions. The OOCRM will receive work plans associated with these activities for comment. Letter sent to OOCRM reflecting this response.

2. Comment: Dr. Arthur LaBruce writes to suggest the possible use of a calcium sulfate product produced by E&C Williams, Inc. as a possible clean up option.

Response: The referenced product identified as "Enthrall" acts primarily by converting inorganic oxides to less reactive sulfides and has shown some usefulness in treating inorganic contaminated soils and wastewater. Enthrall's effectiveness in treating organic contamination, or more specifically the polyaromatic hydrocarbons associated with the coal tar waste present at the Calhoun Park site, has not been tested. Enthrall's most likely application here could be reducing the RCRA characteristic nature of the inorganic waste contaminants (i.e. leachability) so that the waste could be placed in a subtitle "D" landfill instead of a subtitle "C" landfill. As such the parties performing the cleanup (SCE&G) may pursue such a product's usefulness at that time.

3. Comment: Fluor Daniel GTI, on behalf of SCE&G, submitted a letter and attachments dated May 14,1998, recommending phytoremediation over pump & treatment. The general points to be derived from these submittals suggest that a) when pump & treatment technology is implemented at sites where DNAPL is present, the cleanup levels are seldom attained, and b) phytoremediation will both contain and treat the site specific contaminants of concern present on groundwater.

Response: With regards to the first point, DNAPL sites are particularly difficult to remediate regardless of any technology used. This is a substantial point yet one which was not considered within SCE&Gs letter or attachments. To address the technical issue surrounding the remediation of sites containing NAPL contamination, EPA published Directive 9234.2-25 titled Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration, September 1993. The presence of DNAPL at the Calhoun Park site will likely result in a TI approach which is precisely the reason EPA has pursued the threefold groundwater objective of 1) Removal or treatment of NAPL to the maximum extent practicable, 2) Containment of non-restorable source areas; and 3) Restoration of the aqueous plume. To this end pump & treatment would be effective in meeting these objectives over a broad range of sites.

The groundwater objectives as listed above also become crucial in evaluating the manner in which any cleanup technology will be implemented at such sites. Any design document would therefore be based upon these objectives and should discuss specific components required for a TI evaluation including: identification of the specific ARARs or media cleanup standards for which TI determinations are sought, spatial area over which the TI decision will apply, and a conceptual site model.

Because of the lack of actual site data supporting the effectiveness of phytoremediation on PAH contaminated groundwater, the discussions have been limited to theoretical evaluations. These evaluations covered groundwater flow conditions, depth of aquifer, contaminant concentrations, and general research papers on phytoremediation on soils, rather than groundwater. A vital area of concern which has been repeatedly mentioned by EPA but not addressed in any deliverable is the effectiveness of phytoremediation in treating all site specific contaminants of concern. Research does indicate that phytoremediation can successfully treat groundwater contaminated with BTEX and some inorganic compounds under controlled conditions, however there is no research data proving that phytoremediation is effective on PAH contaminated groundwater, nor on its effectiveness through the use of trees.

In effect SCE&G is assuming that phytoremediation will remediate groundwater because of research by Reilley (1996) indicates that plants were effective in reducing concentrations of anthracene and pyrene in soil. A study using grasses to treat two non-carcinogenic PAH compounds in soils would not have any substantive application in predicting the effectiveness of trees on groundwater contaminated with carcinogenic PAHs. SCE&G's assumption that trees would be effective at this site because grasses were effective on another site is unfounded. There is also the additional assumption relating a method that works for soils as being applicable to groundwater. Such an assumption is also unfounded. In effect that which works on soil does not necessarily work on groundwater and that which works through grasses does not necessarily work through trees. Overall the proposal is speculative and therefore are not a solid basis for acceptance as a sole source remedy.

Another problematic issue is also mentioned within Reilley's research yet omitted from the summary offered by SCE&G. The original research paper notes that "Although there is little evidence that microbial growth can be sustained in presence of PAHs with four or more rings as a sole substrate, they may be degraded by cometabolism". Here it is unclear under what conditions for which these higher ring compounds could be expected to degrade if at all. This point simply brings to light yet another unanswered question relating to predicting the possible effectiveness of phytoremediation.

The issue of achieving hydrological containment for the groundwater plume has not been adequately demonstrated for phytoremediation, either by theoretical or empirical means. While a given number of trees can be estimated to remove a predicted volume of water from the vados zone, containing the areal extent of the plume will likely be compromised due to the limited available surface area for planting trees relative to the location of the plume. In other words, while we may be theoretically able to plant enough trees, the ability to place them in strategic locations would be compromised due to existing and/or planned future use of the site.

In summary EPA would not endorsed phytoremediation as a sole source remedy for groundwater at this site based on the research information presented to date. This does not imply that phytoremediation is without merit, but simply that the weight of evidence is not such that EPA is willing to implement this technology as a sole source remedy for this particular site. For these reasons the proposed plan and the Record of Decision includes pump & treatment in conjunction with phytoremediation. The pump & treatment would be installed first to address early cleanup action. Meanwhile a phytoremediation system would be established and its effect on contamination monitored. If phytoremediation proves effective in meeting the cleanup strategy, the pump & treatment system could be replaced by phytoremediation at that time.

APPENDIX C

PUBLIC MEETING TRANSCRIPT

IN RE: CALHOUN PARK AREA

SUPERFUND SITE

PUBLIC MEETING

DATE: March 16, 1998

TIME: 7:00 PM

LOCATION: Charleston Public Works Building
103 St. Philip Street
Charleston, SC

TAKEN BY: EPA

REPORTED BY: LORA L. McDANIEL,
Registered Professional Reporter

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APPEARANCES:

TERRY TANNER, EPA Project Manager
CYNTHIA PEURIFOY, EPA Community Involvement Coordinator

CONCERNED CITIZENS:

BARBARA JOHNSON
PAUL CAMPBELL
RICK RICHTER
PAT McGOWEN
LORRAINE PERRY
DIANE OLDSTON
ROBERT WELLS
ALLEN COHEN
CRAIG ZELLER

MR. TANNER: Folks, if I can have your attention. On behalf of the Environmental Protection Agency, I would like to welcome you-all to the meeting here tonight on the Calhoun Park Superfund Site. We've got a couple of things that we are going to be talking about tonight. And I've got at least three objectives that I hope we can cover tonight during the course of this meeting; the first is an introduction to the environmental district of this particular area of the site. I've got some overheads on the slide; I am going to show you that a little bit later on.

We are also going to talk about contamination and the risk posed by that contamination as well as a proposed cleanup method for this site. Before I go any further, I would like to introduce to you another important part of this team, and that is a lady by the name of Cynthia Peurifoy.

Cynthia is our community relations coordinator. She makes sure all of us bonehead scientists with our slide rulers communicate a little bit better for folks who don't do this every day. She does a very good job.

Cynthia, would you like to say a few

words?

MS. PEURIFOY: Sure, I will just stand over here, if you don't mind. I want to welcome you-all to this proposed plan meeting and encourage you to participate, ask questions and be a part of this decision-making process. As Terry has told you, he's got a lot to cover, and we want you to know this is an extended comment period. We've got 60 days starting today to get your input in.

So take a part of this process. We have an information repository set up at the John Dart Library. There you will find the administrative records, which has all the documentation that led to the decisions that's being made or proposed here tonight. So take some time and go by and take a look at some of those documents.

I also want to tell you we have an 800 number; it's listed there in the fact sheet. Call them. If you go through something, if you have a question or concern, feel free to call and ask a question. We are available for that; Terry and I both can be reached at that number.

We have a court reporter here tonight. When you speak tonight, please identify yourself so that she can record what you are saying and we can have a good record of this because part of this process is to respond to your questions and concerns. With that, I think that's all I have to say; Terry, thanks.

MR. TANNER: Thank you, Cynthia. I will use a slide here to give you a quick view of the site we are talking about tonight. The site consists of the current -- I will describe things in its current context. There's an electrical substation located at the intersection of Charlotte Street and Concord Street. This is also adjacent to the old ballpark. Some of you might have seen it. It's rather grown up and abandoned, but I believe there still is a ball diamond here and a backstop.

Directly across the street we have what used to be the Ansonborough Homes in this area here. These were recently demolished, I think, in the past seven or eight months ago; therefore, none of these structures exist. We also have, as part of the site, as an example, the former Detyen's property, Dockside Condominiums, as well as private land here owned by the Park Service.

If you folks have been keeping up with the news, you've probably heard a lot about the aquarium that they are building in Charleston; you almost have to live under a rock not to. The aquarium itself is located here. It's a source of a lot of ongoing construction activities. We've also got in this area Luden's Marine and Supply. It's a rather old building. They are an outdoor/fishing supply outfitter.

This, in essence, is one of the sites we are going to talk about. This was a very active site over the last 100 years. Some of the industries that have operated within this plot that we know about are an old gas manufacturing plant used to supply town gas to the City of Charleston by the burning of coal; we will get into that a little bit more when. We start talking about contamination.

We also had, at one time, a turpentine plant located here. You can see the outline of where the building used to be. We have in this area -- let me get my bearings. We have an old Navy shipyard that was very active during World War II that serviced minesweepers, as I understand it. And those are the big ones.

Any questions so far? I want to encourage you to ask questions as this goes on. I don't want this to turn into some formalized, complicated thing.

MS. JOHNSON: Could you point to the site that's now the Maritime Center and say that's part of it?

MR. TANNER: The Maritime Center would actually be located, I think, further down here.

UNIDENTIFIED SPEAKER: Right where your hand is.

MS. JOHNSON: That's not part of it?

MR. TANNER: No, ma'am. I think there has been some environmental sampling that has gone on at the Maritime Center but not as part of this project.

What we found in doing our investigation at this site, and you can see -- perhaps you can see it a little better if I dim these lights slightly; see what happens. That's a little bit better.

We literally peppered the site with sampling locations. All of these places where you see triangles and circles with Xs are essentially sampling points. And what we found as we went out and sampled this area was a large volume of a particular group of compounds, which I will abbreviate, polyaromatic hydrocarbons.

And we also found another group: Benzene, toluene, ethene and xylene. Now, both of these groups -- and I will talk about these interchangeably tonight -- are very common contaminants from old manufacturing gas plants.

What the plant used to do -- and the plant actually operated on this portion of the property here -- is they would take coal out of coal mines, ship it in by rail, which you can see here is part of an old rail strip. They would run the coal into this large container, remove the oxygen and heat the coal.

Now, as part of that process, what it does is it extracts this very flammable gas out of the coal itself. And because you are doing it in the absence of oxygen, it doesn't actually blow up on you. What it produces is, again, a very flammable gas, which was distributed throughout the Charleston area for use of the gas line.

Now, as an unfortunate byproduct of this process, it also produced a lot of waste that, again, we call PAHs; polyaromatic hydrocarbons. They are essentially a large family of carbon type materials that runs from the range of being very soupy-like water all the way to the thick, heavier substances you see in road tar. We have a wide range of viscosity, especially with this material, as well as varying compositions of contaminants found within this group of contamination.

What we've seen -- and I will focus in a little bit -- is that when we took our samples, not surprisingly enough, most of the contamination that we noted with regard to soils start there, was along this area here and here and here.

What we also found when we looked at the groundwater samples is, not surprisingly enough, with groundwater flow this way, we found a large dissolved plume-contaminated groundwater, and it goes right through this drawing, something like this, which is not surprising given the sources of contamination.

This will give you a little bit better drawing of what happens environmentally at the site. Initially, you have your release of contamination here. And as it is continually injected into the soil -- poured, dumped, however it may be -- it eventually begins to saturate, and it flows down into -- you can almost read that. What happens, the contamination comes in contact with the soil, goes right on down meantime into the groundwater table.

If you can imagine this as being a solid table of soil, from here to here where the clay ends down here to contain the groundwater, and then here you have a layer of water which is perched upon the ground, perched upon the clay, and on top of that you have nonsaturated soils.

What happens in sites just like this is that the contamination comes in contact with the soil and continues to seep down into the soil. It eventually comes into contact with the groundwater. When it does, you get -- in this direction, you have clean groundwater; here, as it passes through the soil, which is ladened with contamination, you develop contaminated groundwater; thus you end up with a plume like this, much like you see at the site.

Here is an actual drawing of the contamination. It's something like this. Again, you can see where it's corresponding to what we believe to be the source of the contamination here.

MS.JOHNSON: How far down is the plume? How far below the ground level is the plume?

MR. TANNER: There's actually two instances where I believe the contamination is down as deep as 50, 60 foot. Let me ask the drawers, the experts. How far down would you say that is? Do you happen to recall how deep that groundwater contamination is; just in that one area?

MS. CANOVA: I think your estimate is close enough.

MR. TANNER: Okay. What we actually have at this site is a couple of things going on with regards to the soil. I hope to shed some light on this issue. We have, as we mentioned before, clay here. And this particular site, the clay layer terminates at about -- this is land surface. We've got this clay layer down, I think it starts about 12 foot more or, less and it terminates down -- it may run about seven to ten foot.

And we have another layer of soil down here. And then below that, even deeper, another layer of clay. What is happening at the site is we've got not only the contamination, which is down and is perched on top of this clay layer, we also have at one point on the site a hole. And the clay begins itself where initial contamination has come and contamination has come and now it's down into this deeper layer as well.

MS. JOHNSON: How fast is that moving, can you tell, the plume? Is it getting bigger? Is it moving in one direction?

MR. TANNER: Well, we can tell that it is moving simply by the earlier figure where you can look at the groundwater. If this was the original source, it spread at least this far. We can tell that from the wells that we have monitoring it.

In summation, what we have is both soil contamination and groundwater contamination at this site. Are there any questions, at least on this point, before we move on and talk about what we looked at in cleaning up the site?

UNIDENTIFIED SPEAKER: Quick question.

MR. TANNER: Yes.

UNIDENTIFIED SPEAKER: Is there separation between the soil contamination and the groundwater based on PAHs and BTEX? Is one more permeable than the other?

MR. TANNER: Well, in general, the BTEXs tend to enter into the groundwater a little more readily than the PAHs, but we do have both. On this drawing here, I believe this is actually an outline of the, I think, the benzene.

If you were to look at the PAH contamination, because it doesn't absorb in the water quite as readily as the BTEX, we've got PAH; it's looking something like -- little different concentrations -- something like this, and you may have a little bit right there, much like that.

THE COURT REPORTER: Please state your name.

MR. CAMPBELL: My name is Paul Campbell, I'm with the College of Charleston graduate program. So a majority of the groundwater contamination is going to be cleaned up?

MR. TANNER: Yes.

MR. CAMPBELL: BTEXs are as much as 50 feet?

MR. TANNER: I would say that the majority of the size of the plume is certainly BTEX; at least to the further extent. BTEX has migrated faster and further than PAHs.

Yes.

MR. RICHTER: Rick Richter, Trident EQC here in Charleston with DHEC. How is the seepage on Charlotte Street going to fit into the overall picture? Have you-all been able to tie that in yet? Do you have seepage going into the harbor down there?

MR. TANNER: Yes, we have. That's one thing that I will touch on. I will go ahead and do that now. About six months ago, we found, to give you a reference point -- this is, again, where the old gas plant and current site of the electrical substation is now. This is the Cooper River.

As I was saying earlier, about six months ago we noticed that there was a sheen here on the river. We went back and traced the source to a seepage, an outbreak. Along the shoreline here were a series of hairline cracks. It's probably not the correct technical term; it's close enough.

Throughout these cracks, coal tar was found discharging. The majority of it appears to be heavier than water; therefore, it's flowing down into the sediment. However, a portion of it is floating on the surface and can be observed as a sheen on the water itself.

Now, we thought at the time that we had, at least, most of the contamination identified. I'm beginning to feel like Brier Rabbit in a tar patch. What we discovered was there's some additional source area that is feeding these seeps that appears to be coming from the gas holder itself. And this issue, which will not be covered as part of the proposed plan, is under investigation.

And when I say under investigation, I have been working with the gas company, and they have agreed to go in and take some type of interim action, stop this flow while we go on with the normal process of the rest of the site itself.

MS. JOHNSON: Is that green line in front of the Columbus Street terminal site? Is that where that is?

MR. TANNER: Are you talking about the Ports Authority terminal? Is that the same?

MS. JOHNSON: Yes.

MR. TANNER: Yes, it is. Actually, the large cement structures themselves would start about -- this is not, of course, to scale. This is the street, and Charlotte Street terminates here. The seeps are right along this area, feeding out here and the Ports Authority, the actual large pier itself, starts here.

MS. JOHNSON: Is that why Charlotte Street is closed off now at that point?

UNIDENTIFIED SPEAKER: No, that's construction.

MR. TANNER: Yes, I believe they are actually storing -- there is a current, I think, fence and has been a fence all along here. It's actually preventing access to that, but recently due to the construction activities you mentioned, they closed this off and are storing equipment back there at this time. I will just leave that up there so we can continue to reference it.

Let's talk a little bit about -- we've covered the history, the contamination and the risk. What we do once we generate all these sampling data is go back and say, well, what kind of threat is this to the public? What does it mean? What do all these numbers mean?

We take the numbers and through mathematical modeling we determine, statistically, what the risk is to people living in the area. In this site, we looked at a couple of different scenarios. We said, well, if. you have peogle living on the site such as Dockside Condominiums and Ansonborough Homes, there were children out there playing, would there be a risk to them?

We also looked at commercial construction workers. We said, well, if you've got this area covered in commercial property and you have construction workers out there dealing in soil every day, what is the actual risk to them? And we also looked at the trespassers. What is the likelihood of people just wandering up and coming in contact with the soil? What's the risk to them?

And what we found is, in looking at all of those possible situations, the more probable use of this land was commercial. And we said, given that, what is the risk to the construction worker because he is the most likely person that's going to come into contact with contaminated soils? So what we did is crunch the numbers on that and came up with these areas here.

Let me see if I can put this on. What we found out after all our foot and ticking was that these areas here -- and here you can see them slightly shaded; and if you have the flyer that was sent in the mail, the same figure that's on that back page -- you will see that these areas are the ones that posed the greatest risk on the site. Now, this is with regards to soil. We will get into groundwater in a minute. Any questions?

UNIDENTIFIED SPEAKER: Which ones are you talking about, soil?

MR. TANNER: The soils, yes. Let me get this up a little bit higher. See the shaded area here?

UNIDENTIFIED SPEAKER: Looks just like in the pamphlet.

MR. TANNER: It's here and here.

UNIDENTIFIED SPEAKER: Thank you.

MR. TANNER: And for groundwater, as I've shown you earlier on this figure, the contaminated groundwater that will have to be addressed is essentially something like this here.

MS. JOHNSON: Is this including the groundwater contamination map in the handout? Can you print it up? It's a nice companion piece to this soil. That's really nice.

MR. TANNER: Yes, I can do that. Would you like a particular copy of that?

MS. JOHNSON: Yes, this one; at your convenience. Yes, that would be nice.

MR. TANNER: Let's quickly review; history, contamination, risk, proposed cleanup methods.

Are there any questions today, before I move into those areas?

MS. JOHNSON: Groundwater risk; a little bit more about that. Is there anything more to say about that, let's put it that way?

MR. TANNER: Well, we actually took the numbers and ran a risk assessment on the groundwater, and no surprise, we found out that the groundwater does pose a risk. For cleanup numbers -- well, I'll get into cleanup numbers in a bit. Yes, to answer your question. Yes, the groundwater numbers pose a risk.

MS. JOHNSON: I will probably ask a definite question sometime later on, how is that risk modified by the tendency to flood in the area, lot of standing water certain times of the year. Does that change the risk at all, make it a greater risk at certain times during the flooding period, et cetera?

MR. TANNER: What it would tend to do is actually flush the contaminated groundwater out of the more concentrated areas into lower concentrated areas. Use this figure here. Anytime you have rain or flooding, it would percolate down through the soil and increase the amount of water coming into contact with the contaminated material. And the groundwater table would actually rise.

Now, this area is a little more complicated than that because you've got tidal. That's a very simplistic picture.

On most of these sites, Superfund sites in general, we usually have a wide choice of cleanup options available to us. This site is a little unique. In fact, the group of PAHs are unique in that the treatment options we have available to us are very limited. These compounds are very persistent, very hard to neutralize or destroy chemically, and there's just not a lot of options, again, that we can do with them when they are in the soil.

The options that we did look into for this site include a couple of things. We looked at capping it; that is coming back here and placing some type of permeable cap over the material itself. As you can imagine, it might be somewhat effective for the portion of the soil above the groundwater but doesn't do much for the portion below it.

We also looked at bioremediation. That's an issue that's been getting more and more press lately. Bioremediation is where we actually take bugs, or bacteria we should call them, expose them to the soil, and if conditions are favorable to those bugs, they will actually help to break down the contaminants.

We looked at thermal destruction, which is a fancy term for burning the soil. And we looked at landfill; that is literally excavating the soil, getting it up from this area and putting it in a containerized cell to control the landfill.

With regards to the groundwater portion of this, we looked at several different choices; one we looked at, deed restrictions, which is very common to do; simply attach deeds to the land saying don't drink the water.

We looked at phytoremediation. Again, that's a relatively new technology where plants are used to actually help treat the groundwater by infiltration. Roots come down, and through several different means, are actually able to provide some effect in treating this groundwater.

There's a couple different ways it works. The plants in some instances with some contamination are able to actually absorb and concentrate the contamination into the root system and the plant bodies themselves.

There's another mechanism where you also have bacteria that tends to colonize the ground roots themselves. In some instances, that's very effective on contaminants. It can be very effective if the bugs do tend to like that contamination and can digest it; again, a very simplistic, crude explanation of phytoremediation.

We looked at natural attenuation; that is what would happen if we left the site as is and what would happen to it. Under some very controlled conditions, natural attenuation can be an effective remedy. Again, there are some factors that really have to be balanced very carefully in order for it to work.

What else did we look at? We looked at, again, bioremediation, just like soil except this time it will be groundwater; looking for bugs that can actually be introduced to the groundwater and that live in the soil or can live in this particular type of soil and might potentially be effective in breaking down a contamination.

We also looked at a very standard practice of pump and treat where a series of recovery wells are installed; this being the well and slots in the well itself. Groundwater enters the well, is pumped up and on to some type of treatment process it's a filtering mechanism -- and then sent to usually the sewer or, depending upon how clean it is, can even be introduced back into the streams.

Questions, comments about the options? Yes.

MS. OLDSTON: Diane Oldston with the environmental science program, College of Charleston. I have a question. Bioremediation, I understand, is a very quick multiplication of bacteria numbers that might be effective in breaking down the network of contamination very quickly but if bioremediation is a very lengthy process where the root systems have to take . . .

MR. TANNER: Yes, it is. It actually involves several seasons for a particular root to establish itself, and, therefore, it's probably not as quick and a little more difficult to monitor the effectiveness because we can't go out today.

MS. OLDSTON: What is the time line the EPA is focusing on for the treatment? Is there some sort of time line in which you are hoping to remediate?

MR. TANNER: As far as actually implementing a strategy, yes, we will have that implemented within the next ten to 12 months. But because, in this instance I am using the one for groundwater, you can't get down there using the existing technology that we have effectively enough to have the entire area cleaned up in six to 12 or eight months, whatever interval that we are choosing, say, for the soils. What we typically do, we come in, we can treat the soils relatively quickly.

The groundwater is another issue. Depending upon the technology, it takes much longer. It may take a period of years before we can make a dent in the contamination level. That's one area where technology is really lagging behind, environmentally speaking. Once contamination gets in the groundwater, it's very difficult to get to and to treat. It can be done, but it's very expensive.

MS. JOHNSON: I have another question about the groundwater remediation processes. How does the use configuration of these properties affect the selective or the optimum method; being one method might be very good for a forest or a meadow but this is not?

MR. TANNER: Yes, it does. The actual use of the property comes into play and actually at two points: One is when we are trying to determine how clean should we clean this up to; that is, what standard should we use, commercial standard, should we use residential standards; and two is, when we've gotten past that and decided to actually implement the remedy, how is the remedy going to work within the existing conditions.

As we can see out here, the area being by and large commercial where we are certainly limited to options to put in place to do that. So it plays a very good part. Yes.

MS. PERRY: Lorraine Perry from MESNE Register. I have a question. You keep saying that this property is going to be commercial. My understanding is that a lot of this property, especially where the Ansonborough Homes was, is being considered for a park. So that would seem to me that the level of cleanup would be different. And if you look at what the city plans for most of the area, where Ansonborough is, in back of Harris Teeter, in that whole area, if the Ports Authority does leave, is to combine it to be partially residential and partially commercial.

MR. TANNER: Let's look at the areas where we have contamination. Yes, you do bring up a good point. There are areas out there now that are residential; Dockside Condominiums is one of them.

When we looked at the risk and we were assessing the risk, we knew that the electrical substation here was going to be -- actually, technically would be industrial, but from a risk standpoint, it's the same thing as commercial. There's usually no difference.

In this piece of property here we knew there was going to be industrial or commercial. We also knew that with regards to the Park Service property, which is here, that it was also going to be commercial or industrial.

MS. PERRY: How can that be commercial

when you are talking about an aquarium, talking about bringing in umpteen trillion kids every day? I mean, I realize it's commercial because it's going to be a business but you closed this one area next to the gas, SCE&G, where they are going to put a parking garage where the kids play soccer because they couldn't play there because it was too contaminated so you closed them down; just like they closed the Ansonborough Homes down because it was contaminated. And now the mayor says we are going to have a symphony hall on there surrounded by parks for the children.

MR. TANNER: Okay. I think I can answer your question.

MS. PERRY: Good.

MR. TANNER: When we went in and did the risk assessment, what we did essentially, we measured the existing soil concentration; not only at the surface, we also measured them down deeper as well. What we found was that in these areas, in this group of samples here, that there was no -- well, I should say that, in general, none of the soil is pristine; it all has levels of PAHs. Again, what we found, it seems to be concentrated in the area here.

Now, we did find PAHs in this area in the surface soils, but it was not at levels creating an unacceptable risk; that is, children could live here, they could play here, they could go out and eat the dirt if they want to in this area, and it is safe. What we did find out is that was not the case for the areas here.

Now, going back, to your question of how do you say, like, for instance

MS. PERRY: The aquarium.

MR. TANNER: Okay, the aquarium here. I am losing my train of thought.

What is going to happen and the reason why we are calling this commercial at the aquarium is, when we did our first round of sampling, if this was the surface soil, we knew that-- well, it's almost a moot point because these areas here from a surface standpoint are also safe; that is, kids can play on this; it's not a problem.

Going out a little bit further, even if it was, this soil will actually be covered, I think, with a three-foot layer of additional fill material for the landscaping. But I think it's a moot point because, again, these soils do not exceed residential standards.

I believe the only case where that

actually occurred was on the substation itself. I have some reports here I can quickly check hopefully, I can quickly check -- to see if they exceeded in this area as well. I don't believe they did; I think the only place they actually posed a threat, surface soil samples, was the actual electrical station itself.

Does that make sense?

MS. PERRY: It makes sense now. It was a different story at the time they changed it, when they tore down the homes, threw all those people out because it was too contaminated. Since the city bought the property, now it's no longer contaminated.

MR. TANNER: As I understand it, the decision to move the people out of that Ansonborough Homes was based on a couple of factors: Potential threat of contamination as well as substandard building practices. The homes were in bad shape; there was flooding continually. I think it was a little bit of both of those factors together involved, but I am speaking out of school and speaking on behalf of HUD.

MS. PERRY: Okay.

MR. TANNER: Other questions?

MR. WELLS: I am Robert Wells,

Preservation Society. I understand the sites are contaminated. Are there any opportunities to do archeological work? These are sites from the 1800s. Is there any, opportunity at all to monitor as you do the cleanup; can archeologists work in that environment or have any input?

MR. TANNER: I believe that is one of the requirements of doing actual cleanup actions. I will have to go back and check that. We did a couple of archeological digs across these areas here. I believe there were two trenches; here and here. We actually have someone from the Park Service; if you can comment on that, John, from the Park Service; comment on that archeological dig.

UNIDENTIFIED SPEAKER: As part of our development, we are a federal agency, we are required to go through what is referred to as the Wother Process. (Phonetic) We did archeological work on our sites. The two excavations that Terry alluded to were completed back in, I believe it was 1988. We found no remains of any significant structures there. And that determination was made in accordance with the federal guidelines as well as the state's preservation office. The only thing that we found on the site that we did do a site documentation for was the turpentine building located down in the very southwest corner that was remnants of that particular site. It wasn't found as being worthy for any further exploration in that area.

MR. TANNER: Thanks, John.

Going back to your question, I think what you are asking, when we come in and do the actual soil removal, will we? I don't know. I will check.

MR. WELLS: The sites have been occupied since 1867; there may be some very interesting things in the soil we would like to see.

MR. TANNER: If we were to base it on well, we have an additional sampling grid that goes something like this in the area where we came in and did some additional sampling; as you can see, we really peppered the site. It doesn't mean it's loaded with artifacts; haven't found anything yet. In answer to your question, I don't know. I will check.

MR. WELLS: How would we follow through with that? Can you give me a call?

MR. TANNER: Yes, I will exchange phone calls.

MR. WELLS: At the end of the meeting.

MR. TANNER: And we will follow up.

MR. WELLS: Thank you.

MS. JOHNSON: Before we go off on another topic, I found the things that you threw in in an ad hoc way very interesting. In addition to the map showing the groundwater contamination, it would be nice to see the entire site with some markings on it as to not only where the contamination is found but those sites that are not contaminated so that the whole Calhoun Park picture -- these are not, these are not, these are, these are -- all in one place, that would be nice because it's the information we came here to talk about.

MR. TANNER: I agree. These drawings are very piecemeal. Prior to the conclusion, I will get some type of figure that shows the study area in a much more presentable manner rather than what we are seeing now because, obviously, the site is now expanding off of here.

MS. JOHNSON: That's right. Thank you.

MR. TANNER: Administratively what we will do as part of what we are required by law is, essentially, make sure that we keep you folks up-to-date on what we do know and what we are proposing for those areas that we do know about.

I will digress a little bit before I get to the last method. As part of EPAs process, we work with the community. What we do is we go through an outline much like this, come to the public and say, this is the contamination, this is what we propose to do.

Unless it is an emergency action, we tend to go through steps like that and make sure that you folks stay involved; you know what we are doing. We are not out there doing something that you don't know about.

Let's go into this last item and then we will just open up the meeting to general comments or feedback or whatever. In looking at all of the possible options, both the cleanup of soils and the groundwater and something which I've neglected to mention, which is this dark pool of stuff that's sitting down here that is in these handouts. What we are proposing to do is three things.

With regards to the soils, after considering the entire universe of options, we are proposing to excavate the soils, take them to a controlled landfill.

With regards to the contaminated groundwater, we are actually trying a two-fold approach: One is the standard pump and treat. We are also going to work as best we can with phytoremediation in with that. We are going to use essentially the pump and treat as the frontline treatment.

MS. JOHNSON: Is that source removal? Pump and treat means source removal?

MR. TANNER: No, ma'am. That would actually be another issue. I will mention that next. That's a third thing.

With regard to this dissolved phase of the groundwater, it will essentially be a two-fold approach. We will use pump and treat until we can get phytoremediation established underground, Hopefully, what we would like to do is, if we can get out there and show that, yes, indeed, the tree roots are coming down and they are beginning to destroy the contamination, we can back off this additional pump and treat mode. At that time, we will come back to the public and say, this is what we found; it works or it doesn't work. This is what we are going to continue to do.

Now, the third item is the dark liquid here. This is actual saturated contamination liquid pools of these PAHs, this coal tar and BTEX as well. And what we are going to do on these areas, because it's so concentrated, get right to it; we are going to go in with a well; literally seep it right down in this area.

So the opening here is actually collecting this product. It's more of a way where we can pump on this and pump and pump, and it's not going to be nearly as effective as a combination of going in and actually going after the actual source itself. That in a nutshell is the proposed plan.

UNIDENTIFIED SPEAKER: How big is this excavation? Are we just going to see this massive excavation ten or 15 feet down and planting trees in it?

MR. TANNER: What we are going to do, you will be seeing this excavation rather soon. We are actually going down from land surface. We are going down to about three foot, which in this case is virtually right on top of the water table.

We are going to excavate down from the land surface, down to right at three foot on these areas that you will see here, here. Let me put up the areas it's in. These have been merged; is that correct? It's more like one or something like that. There's another area here.

Our concept is go after the highly

contaminated concentrated areas.

MR. COHEN: I have a question for you. My name is Allen Cohen. You seem to focus mainly on the rehab. Do you have any free product here? Is there free product versus you focus where there's apparently some contaminants in the aqueous phase? Is there a second phase on top of the water table? Do you have any gasoline or gasoline type products?

MR. TANNER: At one point in the investigation, we did notice some type of product, and it would probably be -- I will use this.

A little background on the gentleman's question. Most chemicals are either heavier than water or lighter than water. The ones that are heavier, (sic) obviously, float and form the NAPLs that we talked about. The BTEXs that we also have at the site tend to be lighter than groundwater and they float. What we've seen based on this particular site history is the sinkers tend to be in this area here.

Now, at one point we did observe some floaters out in one of these wells, I think it was MW12. We've since gone back, at least once if not twice, and I have not seen any floaters since then.

Now, does that mean that they were there because of one freak incident? I don't know; we will continue to monitor this to make sure they don't pop back up, if there is not some other little pocket source area out here that we are not seeing.

MR. COHEN: Are you getting any downgrading of those wells? I don't know which way the water is flowing in that direction.

MR. TANNER: Groundwater is flowing this way, directly towards the river. And your question was?

MR. COHEN: I was just wondering, in response to your answer, do you think it could have migrated past that well? Do you have any wells like that well more than you once did?

MR. TANNER: Yes. The question is, is the contamination migrating past this last well. On some of the samples, yes. On some of the sampling, yes; on others, no. So what that tells us, going back to this plume, is that depending upon, I guess the site conditions, at any given time, the season probably has as much effect on this as anything.

As you can see, this is a -- I will try to enhance it a little bit. We've got 100 micrograms per liter. I shouldn't do that; I don't know what it Is. You can see it ends right here.

I guess beyond here we really don't know.

We came back in and sampled those particular wells again, and we weren't getting -- well, the concentrations were different. They weren't extending all the way out. But there's a good chance we could come back in two months again, resample, and it will look just like this.

Groundwater is in a very dynamic state; a lot of things going on. Obviously, what we hope to do is, based on our actions taken, to stop this plume from discharging into the river.

That's the three big items. Now, at this point, this is going to end the formalized presentation. Let's open it up to general questions. I am sure there's a load of things I might have glossed over or whatever. Question?

MR. CAMPBELL: You might want to put the slide back up of the recovery well sites. My name again is Paul Campbell, I am with the College of Charleston. The way in which the screen is set up with the proposed recovery wells, we've got two in the back that kind of look like little linebackers. Is there a purpose? Is there a preferential back way?

MR. TANNER: Yes, we have. This other groundwater slide, this slide, is easier to address the general concept of this issue here. These would be crude estimates. The points might actually work out to be something like this, this and this. Who knows?

We will do all our groundwater models that will tell us where we should best put them. Maybe it works out to be something like that; again, just an estimate; something to get the idea across that something is going on here, again, in the same place as we noted as those floaters before.

MR. CAMPBELL: We didn't expect the screen of wells that you've got, the ones that are boxed, those two that are set back, to collect groundwater plume and perhaps capture those; those two further back.

MR. TANNER: Yes, that is our intent. What we are running up against is, if you get too close to the river, you start recovering water from this way--

MR. CAMPBELL: Right.

MR. TANNER: -- rather than that way. We want to avoid pumping the Cooper River and cleaning it up although that may not necessarily be a bad idea. I don't think it would be appropriate to ask the gas company to do that in this case.

UNIDENTIFIED SPEAKER: That would be a big project.

MR. CAMPBELL: What's the life cycle on these? What's the estimated time it's going to take to do the groundwater cleanup work?

MR. TANNER: We don't know. We will install the system probably within the next ten to 12 months. As far as how the aquifers is going to respond, they all respond a little bit differently.

MR. CAMPBELL: Was that included in the estimate cost and the options?

MR. TANNER: Yes, it was. I believe for estimation purposes, the cost was put out at 30 years of operation.

MR. CAMPBELL: That's alot of work.

MS. JOHNSON: That's kind of a leading question. You just used the word aquifer the first time. You just said it was a lot of work. Talk about the amount of water; talk about the direction of the flow. Where is it coming from? What is the water pressure? What is the velocity of the flow through there?

MR. TANNER: I am not sure I can answer all of your questions. I will try to answer the ones that I can and see if we can get you additional brainpower from the room. Groundwater at this site tends to flow as in throughout all the peninsula. It tends to flow from inland out towards the river. That occurs through a variety of actions.

On this particular piece of property, groundwater is flowing this way. Judy, do you happen to remember any of those specifics about flow rates?

MS. CANOVA: I think we were looking around 100 feet per year. We have to look it up; that was the general idea; 100 feet per year.

MR. TANNER: Keep in mind that what this means, although the groundwater may be flowing at 100 foot per year -- there's my scale -- that doesn't necessarily mean that the contamination is keeping up with that.

What happens is the contamination tends to attract the soil. There's a lot of factors going on. It's not flowing, obviously, 200 feet per year. If it were, this site has been in operation or did operate over a one-hundred-year period, this would be washed clean.

I can get you specifics on those numbers. I just don't have them.

MS. JOHNSON: Sure. Thank you. Another question; the brochure for this meeting said that you were in the process of selecting remediation methods and yet you are kind of talking about you have already selected the remediation method.

MR. TANNER: What we've done is that -- to answer your question, what we actually do during this meeting is propose cleanup methods. I may have used those two words interchangeably; if I did, my apology.

MS. JOHNSON: Looking at the chart, which one is closest to the proposal?

MR. TANNER: Talking about the groundwater?

MS. JOHNSON: Yeah. Which one is closest to your preference right now, put it that way? What seems to you to be the best?

MR. TANNER: The one that would be the closest would be the one just before the last one, the source removal, phytoremediation, the grout curtain, which has been eliminated.

MS. JOHNSON: Why was that eliminated?

UNIDENTIFIED SPEAKER: More work.

MR. TANNER: There wasn't any great benefit from having it in there. It is a rather expensive part of that package.

What actually happens when we get a study in that evaluates all these options is, the responsible parties, potentially responsible parties, send us a document that says, here is what we think are some reasonable options.

And we all sit down, and we look at those options and we evaluate it from an engineering standpoint and say, well, this one looks reasonable from this perspective, but it has some shortcomings here.

And on the chart it essentially lists out the way we evaluate. We try to do them as fair and as objectively as humanly possible.

MS. McGOWEN: Is it cost effective analysis and whether financially it'll be feasible to actually get it done and do the job?

MR. TANNER: Yes. The cost of it is part of it as well.

MS. JOHNSON: Four and 5 look the same.

MR. TANNER: My apologies, yes. The one that we are implementing is actually the last one.

MS. JOHNSON: As far as the soil cleanup option, I think you said the landfill, off-site landfill, was the preferred?

MR.TANNER: Right.

MS.JOHNSON: Where are there landfills

that would take stuff like this? Are there any
places?
UNIDENTIFIED SPEAKER: Laidlaw.
MR. TANNER: Laidlaw is still operating.
MS. JOHNSON: You are naming a company. I am saying where.
MR. RICHTER: Some of that goes to Chambers Oakridge. I'm a hazardous waste consultant for DHEC.
MS. JOHNSON: For the project?
MR. RICHTER: For this district. We oversee the disposal of soil. Some of that soil could go to Chambers Oakridge. It doesn't exhibit the characteristics of a hazardous waste. It's not a listed waste. In some cases it doesn't meet the characteristics. So it can go to a subtitle D landfill. A lot of it probably has already gone there. That landfill has check control.
MS. McGOWEN: Oakridge where?
MR. RICHTER: Chambers Oakridge up in Dorchester County.
MR. TANNER: What we'll actually do is characterize the waste. Actually we've done some preremoval characterization of the waste.
Because of the expense involved in

sending it to a, quote, unquote -- I am trying to avoid all the nomenclature and buzz words in the environmental group. There's a difference between contaminated waste versus RCRA contaminated waste. They have to be handled a little bit differently. The waste that is a RCRA contaminated waste has to be sent to a special facility.

MS. JOHNSON: What was the word again?

MR. TANNER: RCRA. It's Resource Conservation something.

MS. McGOWEN: Resource Conservation.

MS. JOHNSON: I would like the person in charge here to answer the question. Go ahead.

MR. TANNER: Okay. Let me go back and get a global view of what we are doing with the waste. The waste, obviously, is not all contaminated in a uniform manner. There are areas that are very hot cleanup goals as well as there are other areas that are not as hot as those but still exceed the cleanup criteria. You might have some that are -- and I don't know the actual RCRA numbers, but we will when we actually put it in these disposal facilities. You might have some of these areas that are 100,000 parts per million or greater in these little pockets but what you will find is it's not all uniformly contaminated.

What we try to do for cost purposes is to say, where can we send this waste if we don't all have to send it to a place that charges us $50 a ton. And this is one area of waste disposal that is also regulated by the Environmental Protection Agency as well as DHEC.

We say, where can we send the waste. Do we all have to send it to a subtitle D facility or can we send a portion of it to a subtitle C facility? They both offer containerized storage; one just offers a much more higher level because the waste in turn is more hazardous. I'm hesitant to use the term more hazardous because it's all hazardous. We get in there with little subtleties of what we are doing here; a disposal that is cost effective.

MS. JOHNSON: Now we are at the point where I can ask the question again: Where are the sites that can take, for example, class C and class D contaminants?

MR. TANNER: Pinewood, South Carolina is subtitle C.

MS. JOHNSON: Thank you.

MR.RICHTER: Chambers Oakridge in Dorchester County is subtitle D. They got a line.

MS. JOHNSON: Where is that, please?

MR. RICHTER: Dorchester County, South Carolina.

MS. JOHNSON: You used a name, Chambers?

MR. RICHTER: Oakridge.

MS. JOHNSON: Chambers Oakridge. That's a place name, Chambers Oakridge?

MR. RICHTER: Uh-huh.

MR. TANNER: If it's any comfort --

MS. JOHNSON: That's B you said?

MR. RICHTER: No, that's a subtitle D.

MR. TANNER: They have smart people on -- like this gentleman -- the project so people like me aren't making the decision. We can say, these are the levels, where can we dispose of them?

MR. RICHTER: Can I ask a question before we quit?

MR. TANNER: Yes.

MR.RICHTER: The future parking garage fits right along the edge of the contaminated soils that's going to be excavated. Is that drawn like that because the soil is going to be excavated before the future parking garage is built, or does it actually run straight down in a line like that?

MR. TANNER: It's not exactly a straight

line, but the garage looks something like this. And it will be, excavated prior to the garage going in place. The garage itself is -- I don't know -- something like this. There's about a 20-foot quarter, I believe, in this area here where we are going to be moving that.

UNIDENTIFIED SPEAKER: That is actually under the parking garage where you are going to move it?

MR. TANNER: It's going to be close, it's not exactly under. The removal will precede the construction of the garage itself. We may be out there digging around and find a little pocket right here and come out that far; something like that. But after we are done with that, the garage will come back and cover this. It would probably have been a more descriptive figure if this wasn't here, if that's causing some confusion.

MS. JOHNSON: According to the City of Charleston, the size of the parking garage -- this was public information at a zoning meeting ten days ago -- the configuration of the garage was related to your remediation plans, if that's what you said.

Is there any chance that with some possible change in the remediation plan that will impact it? I am not asking an alarming question with everything still in a developmental stage here.

Is there any chance that there may be other changes in the use of that area -- the size of the garage, how far it extends into the area that's requiring remediation, in the whole configuration? Is there any chance that there will be further modifications of the planned construction, do you think? I am asking a what do you think question.

MR.TANNER: Let me see if I understand your question.

MS.JOHNSON: Sure.

MR.TANNER: Would changes to the garage blueprint itself affect--

MS.JOHNSON: No, the remediation plans; are there additional further developed remediation plans? Will they impact the garage site, the configuration of the site, do you think?

MR.TANNER: I don't think so.

MS.JOHNSON: You think you are far enough along so that you feel sure? You have enough area for pumping and digging wells and the various methods, enough space to do all that? I guess that's the question. Do you have enough space to do all those things?

MR.TANNER: Yes, we do. It's been a juggling act, working with all the different agencies to make sure that we can clean the site up, put it back into productive use. Even if things change again, we will modify whatever we are doing to a limited amount; obviously, not going to go in and completely change the remedy because of something and then go out and do it.

MR. ZELLER: Along that line, actual cleanup numbers that are issued, maybe to help answer the question, if the number is 50 for PAHs, all soil that is greater than 50 would be excavated, just for an example.

So as Terry mentioned, had they estimated a certain amount of volume above 50, that will have to be excavated. If that number goes up, excavate everything above 50. Once they are done with that, they have to backfill in or whatever. It's not a manual situation. They can come back in and develop it as the aquarium and parking garage and everything else.

MR. TANNER: Yes. These cleanup numbers are driven by risks so we have to follow up.

MR. ZELLER: Of course, it's unknown to some degree; shouldn't triple or quadruple.

MR. TANNER: There's one group here -- let me introduce this group. Mike Hammerpart is on this project with the State of South Carolina, and he's sitting in the front row. I would like them to introduce themselves. This is the group here in South Carolina that I work with.

MR. COLEMAN: My name is Ken Coleman, I am the manager of the Superfund in South Carolina.

MR. HAYNES: Richard Haynes, I'm the state project manager for the Superfund.

MS. CANOVA: Judy Canova, project geologist.

MR. MALERO: Eric Malero, Division of Health Hazard Evaluation.

MS. JOHNSON: Do you have your operating offices nearby?

MR. HAYNES: Columbia.

MR. TANNER: Thanks. I work with these folks a good deal on the sites. When we get the reports in, we get together and we review them and we go back to comments, work out the technical details to make sure that we are in agreement. It's a system of checks and balances.

Yes.

MS. MAREKI: Do you know yet what kind of plants you are going to use for the phytoremediation?

MR. TANNER: We have looked at oak trees. And I don't know if we've looked at any other specific species beyond that. Walter, could you elaborate on that?

UNIDENTIFIED SPEAKER: We've looked at several different species working with the City of Charleston on the type of criteria that they have on the listing of approvable trees. So we are trying to stick with the same type of vegetation they have around the city and around the area, but there's going to be a couple different; not just one species.

MR. TANNER: Yes.

UNIDENTIFIED SPEAKER: It seems that if the roots of the tree are sucking up all this stuff, the tree would die.

MR. TANNER: In certain concentrations, it would be toxic, obviously. The levels that we are seeing here in the groundwater don't appear to be toxic to the plants.

Now, if we were to plug down a tree right into this heavily contaminated soil area, it might kill it. But if we are looking at phytoremediation from the perspective of groundwater, we wouldn't do that. Again, on these groundwater concentrations we are seeing here, we don't think it's going to affect it. The bigger concern is, will it work.

A couple of things I wanted to mention briefly while I'm on this subject before our meeting draws to a close. We have done some sampling out here in the sediments and found that we've got some contamination, let's see, here, and this isn't exactly to scale; it's more or less; and we found some more here. And, of course, with the outbreak of this seep here, it's a good bet we've got some contamination out here as well. I will be back to discuss that at a future meeting.

One of the things I wanted to do for purposes of this meeting was to address specifically the soils and the groundwater. We want to get moving on that. And we will be addressing those soils at another point in time.

What you guys are going to see within the next month or two months is some activity on these soils here. SCE&G has agreed to go in and do a removal action on these soils concurrent with the proposed plan. We are also working with them to take some type of action on these seeps at that same time. So, again, within the next couple of months, you are going to see a good deal of activity out here; just know that that's what it's for. Questions, comments? If not, we will try to wrap this thing up and get home. Yes.

UNIDENTIFIED SPEAKER: Could we have a little bit more advance notice? I received this Friday.

MR. TANNER: Yes, my apologies. That should have been handled better.

MS.JOHNSON: This has been a good meeting. This will be on my desire to hear more.

MR.TANNER: I hope it's been helpful. At least you've got some idea of what's going on. Yes.

MS. McGOWEN: If I can beg the group's indulgence for a moment. I have been trying to get some help with a problem. I thought maybe I might collar the right people in this room.

I own Turkey Creek in Sumter, one of the most polluted areas in the state. We've got pollution for almost 40 years; cadmium, lead, mercury, chromium. Our numbers are a lot higher than what you got on this sheet.

We've had eight corporations polluting us with impunity; no one has even looked at cleaning up the problem. It flows into the Pocotaligo River.

The City of Sumter is thinking about taking some dredges and going in and opening up the waterway without permit or notifying the right people and will probably resuspend a lot of stuff that you don't want resuspended.

The reason they are doing this is because they have got almost 60 acres of my property under water now, and I'm drowning. This is the last battleground of the Civil War and the 54th regiment, the Glory guys, are buried on my land, and I need some help. And I hope that lady over there is typing this. So to go on record, my phone number is 556-9487, and I expect some phone calls in the morning. Thank you.

MR. TANNER: I don't get that at every meeting. I will, ma'am. I will call you.

MS. McGOWEN: Thank you so much. Your name?

MR. TANNER: Terry Tanner. I will meet you after this.

MS. McGOWEN: We will do lunch.

MR. TANNER: Everybody has my number.

(Thereupon, the hearing was concluded at 8:30 p.m.)

CERTIFICATE OF REPORTER

I, Lora L. McDaniel, Registered Professional Reporter and Notary Public for the State of South Carolina at Large, do hereby certify that the foregoing transcript is a true, accurate and complete record.

I further certify that I am neither related to nor counsel for any party to the cause pending or interested in the events thereof.

APRIL 6, 1998

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